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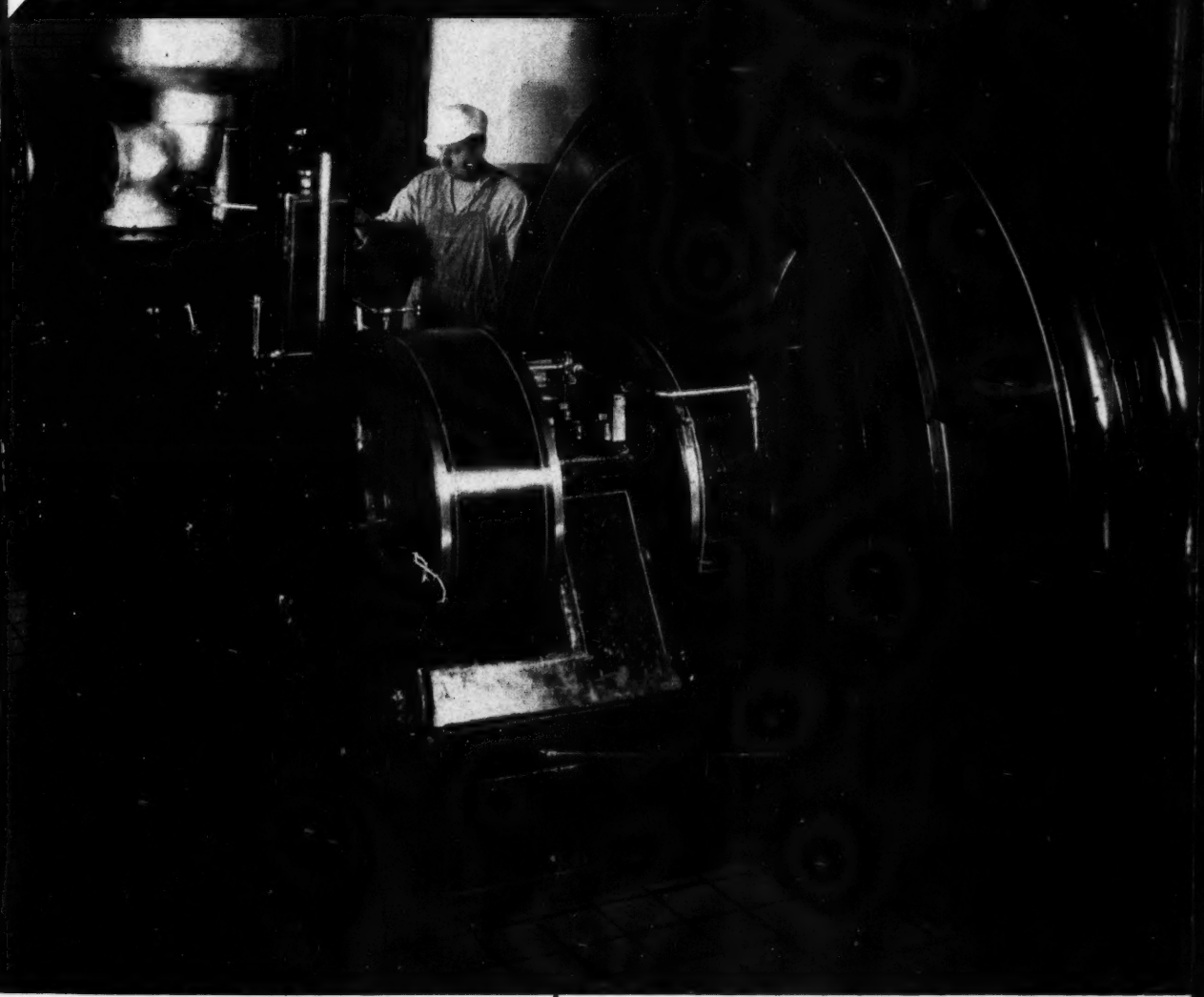
Power Plant ENGINEERING



THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

MAY • 1946

Features

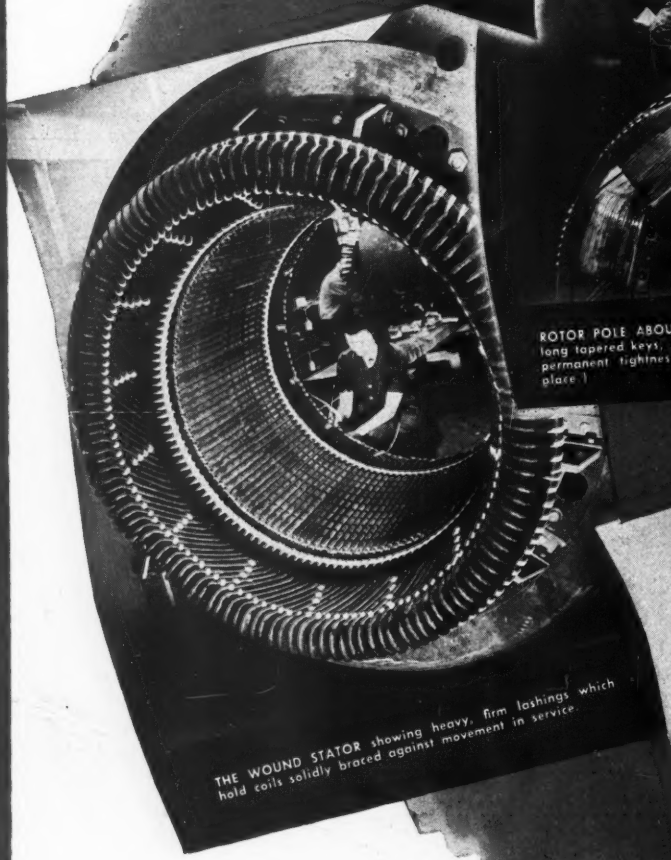
ELECTRONIC FREQUENCY CONVERSION • SEAPOWER • NAVY TESTS GAS TURBINE AT 1350 F • PUMP PRIMING • COAL BUNKERS AND SILOS • EXTRACTION TURBINES • ATOMIC BOMB PROCESSES • BOLTING • • • • CONTENTS PAGE 5

Exceptional construction

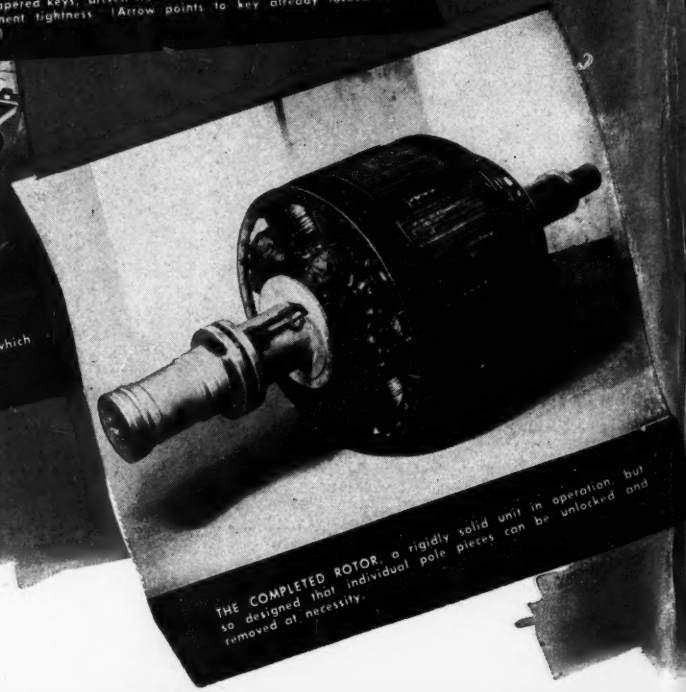
COLD RIVETING ROTOR SPIDER LAMINATIONS. Extreme hydraulic pressure expands rivets to the full diameter of the hole over their entire length, preventing any movement of laminations in the stack under most severe operating conditions.

ELLIOTT DIAMOND CAGE WINDING — heavy bars inserted in slots in the pole piece, joined to end ring segment by a silver brazing process in a permanent bond which tests out as stronger than the parent metal itself. The laminations of the pole piece are cold riveted together.

ROTOR POLE ABOUT TO SLIP INTO DOVETAILED SLOT, where long tapered keys, driven from each side and upset, will assure permanent tightness. (Arrow points to key already locked in place.)



THE WOUND STATOR showing heavy, firm lashings which hold coils solidly braced against movement in service.



THE COMPLETED ROTOR, a rigidly solid unit in operation, but so designed that individual pole pieces can be unlocked and removed at necessity.

methods *that distinguish*
MOTORS *by* ELLIOTT

You can easily "prettify" the outside appearance of a motor—but that won't affect the appearance of its performance record. Only sound construction will help there.

By **sound** construction we do not mean **expensive** construction. Some of the methods used in building Elliott motors cost little or no more than what may be called standard practice. Other procedure may run to definitely higher time outlay, with, however, a beneficial performance result that places the slightly higher overall cost in the category of a most profitable investment.

Elliott motors are custom-built, engineered with characteristic Elliott thoroughness. In their building, no expense is incurred which is not amply justified—and no time or trouble is spared which will further their long and faithful service. When you need a fine motor, closely adapted to a specific drive job, discuss it with Elliott. Informative bulletins at request.

ELLIOTT COMPANY
Electric Power Dept., RIDGWAY, PA.
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
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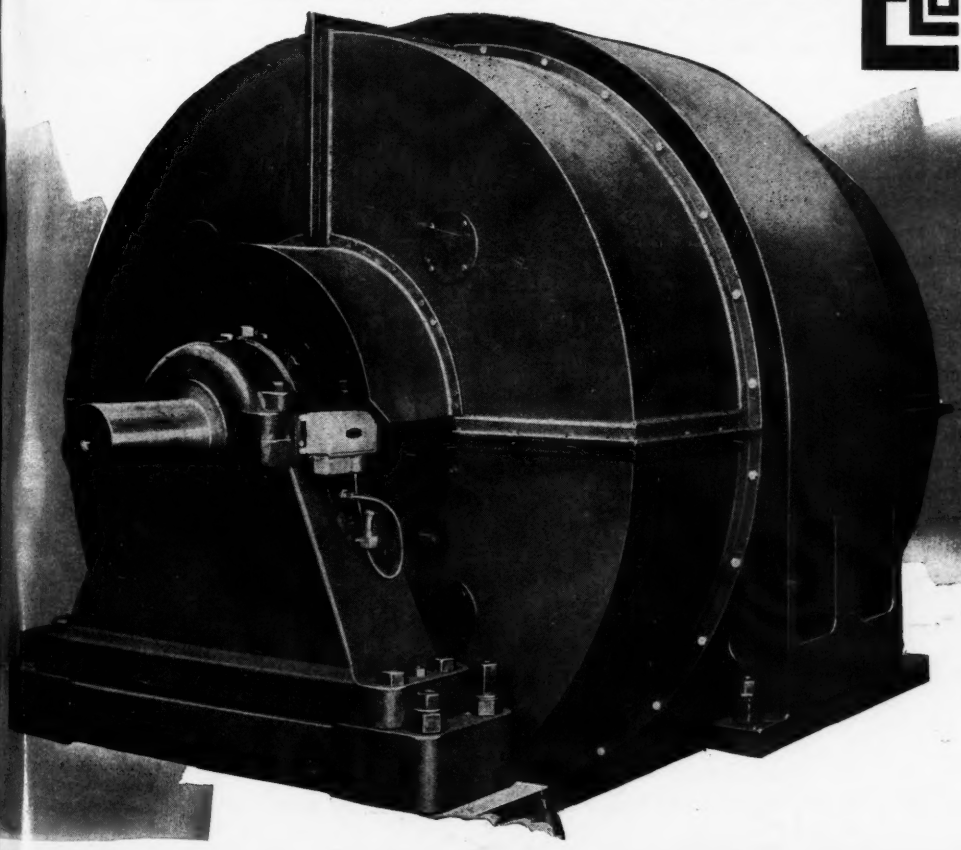
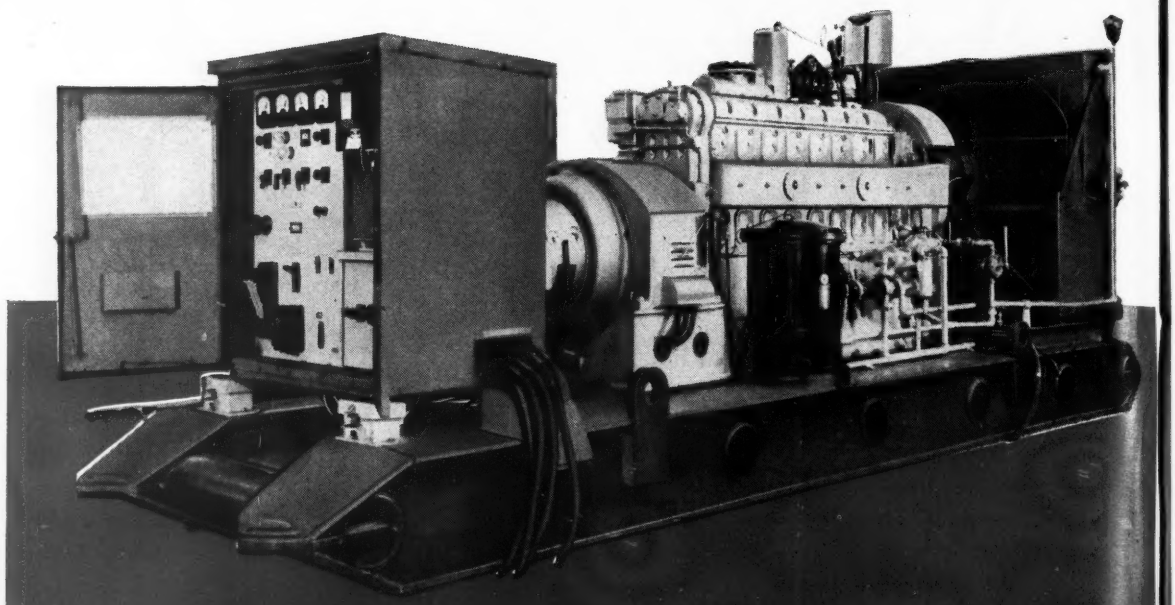


THIS TYPICAL ELLIOTT SYNCHRONOUS MOTOR is one of a group built for a waterworks pump drive job in an important municipality. It is 1750-hp., 720-rpm, self-ventilated, with drip-proof construction. The methods used in its building have been developed by Elliott motor engineers over an extended period, and have each contributed to the outstanding success and high reputation attained by Elliott motors in a wide range of applications, many being exceptionally exacting and difficult. A few of these Elliott construction methods are illustrated on the facing page.



Dependable, Economical, Performance from Diesels OLD or NEW

WHETHER your Diesel is brand-new or an "old timer", it will operate more efficiently—use less fuel—when lubricated with *Texaco Ursa Oils.* These world-famous oils keep engines clean, rings free, valves active—reduce wear of bearings, rings, liners and pistons. Their use assures greater power, fewer overhauls and repairs.

Texaco Ursa Oils have kept pace with improvement in Diesel engine design over the past 30 years. They come in every grade necessary to assure effective lubrication of every size and type of Diesel. Because of the many benefits they deliver, *Ursa Oils* are approved by all leading Diesel engine manufacturers, and used by thousands of operators everywhere. In fact . . .

More stationary Diesel h.p. in the U. S. is lubricated with Texaco than with any other brand.

For Texaco Products and Lubrication Engineering Service, call the nearest of the more than 2300 Texaco distributing plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO REG. T. M.

TEXACO Ursa Oils

FOR ALL DIESEL ENGINES

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT STARRING JAMES MELTON WITH HIS GUEST, ED WYNN—CBS

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Power Plant ENGINEERING

May, 1946

VOLUME 50 — NUMBER 5

Cover: "Still going strong after 34 years continuous service" is the way Chief Engineer Wm. Robertson described this 150 kw engine generator set in the Chicago plant of Wm. Wrigley, Jr., Company.

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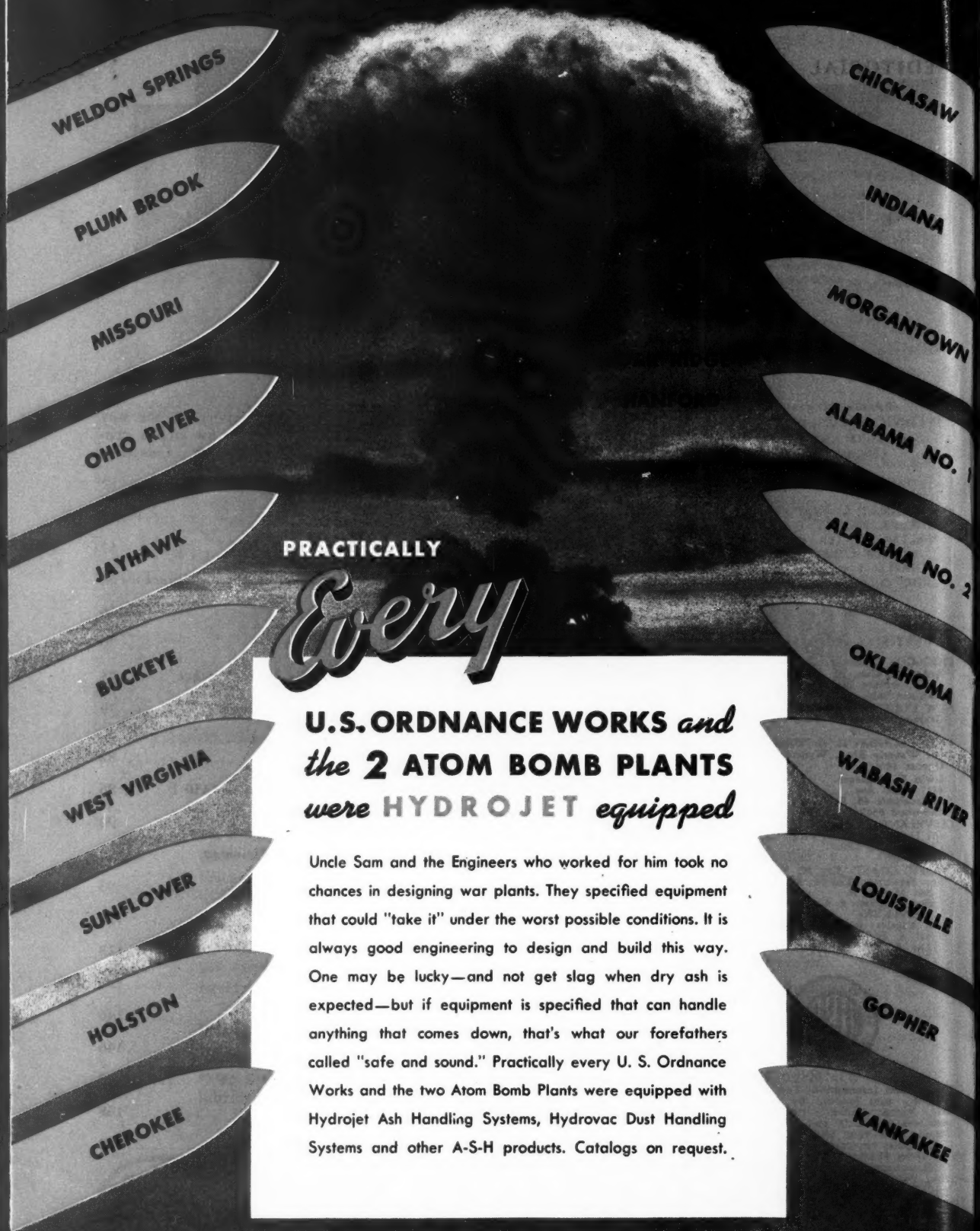


PRACTICALLY

Every

U.S. ORDNANCE WORKS *and the* 2 ATOM BOMB PLANTS *were* HYDROJET *equipped*

Uncle Sam and the Engineers who worked for him took no chances in designing war plants. They specified equipment that could "take it" under the worst possible conditions. It is always good engineering to design and build this way. One may be lucky—and not get slag when dry ash is expected—but if equipment is specified that can handle anything that comes down, that's what our forefathers called "safe and sound." Practically every U. S. Ordnance Works and the two Atom Bomb Plants were equipped with Hydrojet Ash Handling Systems, Hydrovac Dust Handling Systems and other A-S-H products. Catalogs on request.

ALLEN-SHERMAN-HOFF CO., 233 S. 15th St., PHILADELPHIA 2, PA. *Offices & Representatives in Principal Cities*

Front Lines

FLEXIBLE metal hose designed for handling hot corrosive fluid at pressures up to 2000 psi and temperatures up to 2000 F is now available, a result of aircraft applications during the war. It comes in two different "pitches" — normal and close, the latter having more corrugations per inch for very high flexibility.

AN AVALANCHE of letters has descended upon us—well, three, if you must be so accurate—from language purists, Latinists or Latin-ologists or whatever they are and from other assorted critics, taking our hide off for rendering Dr. Vannevar Bush's famous motto as ILLEGITIMUS NON CARBORUNDUM. We are informed by these critics that a much better rendition of it would be NE ILLIGITIMI CARBORUNDUM—better because it's closer to the correct Latin construction, hence less confusing to those in the know. Since the whole business is pseudo-Latin anyway, who cares?

IGNITION of solid fuels in air and oxygen was being investigated in a new type of reactivity equipment some time ago. Ignition is more easily obtained in oxygen than in air but the effect of oxygen concentration has not been known with certainty. Evidence is that the reactivity during ignition does not increase directly with oxygen pressure, as often assumed, but at a lower rate. In some cases, increase in oxygen pressure has little or no effect.

THE LARGEST ROOM in the world, said Bruce Barton, is the room for improvement. And, adds Parks' Parables, the room for improvement isn't peopled by defeatists, whose mental attitude is "It can't be done."

POLYSTYRENE materials of the 1200 Lustron series have been developed that have an after-glow potency more than double that of prewar phosphorescent plastics. Because they glow visibly six or eight hours after exposure to light, they should be useful on wall switches, light cords, drawer pulls, telephone dials, clock faces and instrument dials. They are available in several colors.

ARCTIC, a new valve steel for impact strength at low temperatures, is now available. Steels had already been developed to meet the commonly specified minimum of 15 lb Charpy impact at temperatures from —50 F to —75 F. But increased use of chemical processes operating at —150 F and lower, pointed to the need for cast steel even more resistant to low temperature embrittlement, which led to the development of the Arctic steel for valves and fittings for such service. This may be good news for some of the people who are toying with ideas about low-temperature power generating cycles.

DR. REINHOLD RUDENBERG received the Stevens Honor Award for notable achievement in the field of "Electron Optics" as the inventor of the electron microscope at the 76th Anniversary Annual Dinner of the Alumni of Stevens Institute of Technology. Dr. Rudenberg, now Gordon McKay Professor of electrical engineering at Harvard University Graduate School, is also consultant to the Farrand Optical Co. of New York, which, under his guidance, is developing an electron microscope of advanced design.

TYGON corrosion resisting paint has been developed as a protective material for tank exteriors, structural steel, walls, floors, ducts, pipe, brick, stone and for underneath machines and equipment. It is also intended for interior of tank cars and other containers handling mild corrosives. It is applied cold, like ordinary paint, by spray gun or brush.

REALISTIC PLANS for future development of two- to six-lane highways designed to satisfy the type, purposes, and volume of motor vehicle traffic were revealed by Herbert S. Fairbank, before the Annual Meeting of SAE. He described the plans as visualizing city streets, main highways, and rural roads as elements of a nationwide highway system unaffected in its natural development by political boundaries and partitioned administrative authority.

SECURITY ANALYSTS consider corporation reports to stockholders "generally inadequate" and must resort to "digging up their own supplementary information" to be able to appraise relative merits of securities. That was the conclusion of a recent survey by M. K. Mellott & Co., public relations firm, based on replies to a questionnaire from 123 professional security analysts, officials of banks and insurance companies and brokerage firms.

CAN YOU USE such things as 6-in. self-lubricated, single-sheave steel blocks at $1.08 each? Or new forged-steel safe line clamps at 17 to 25 cents each? Or new cast-iron, black, 3-bolt type wire rope clamps, ⅜-in. to 1-in.? Or wire rope clips, hooks, steel shackles, wire rope slings, Diesel engines, waterproof suits, winches, refrigerator barges, "Sea Mule" tugs, gasoline engines? If so, better look into the Marine Surplus Seller, a catalog now being published by the U. S. Maritime Commission to show the surplus property it has for sale. The items quoted above are only a few of the listings. The commission has section offices in many parts of the country and if you have trouble finding one, we'll gladly give you the address of the one nearest you.

SHOULD WE HAVE internationally standardized screw threads? This question has been debated at various times for the past century. But usually the needs of a particular group or section of industry has been the only consideration. The subject arose during World War I but no agreement could be reached on it then. In World War II it came up again, with much discussion of the losses incurred by lack of international standards. This time, a study is being made, conferences have been held in London and Ottawa and as soon as some facts are available, some action may be possible by the English-speaking countries.

HEATING of a group of residences from a central coal-fired plant has been studied intensively at Battelle to determine the most favorable arrangements. The first progress report, which gave estimates for the heating of 40 houses with circulating hot water, showed a questionable competitive position for coal as compared with gas and oil, under fuel prices then existing in Columbus, Ohio. A second progress report, now in preparation, will include an analysis of 80-house and 120-house projects. The Ric-Wil Co., piping manufacturers and other equipment manufacturers, have co-operated in the project. A publication for architects, engineers, builders and utilities is contemplated. Many inquiries show wide interest in the project.

MILLIONS OF VISITORS to the Smithsonian Institution glimpse only the fringes of its collections and catch no more than a hint of their meaning. To free this accumulated knowledge from the confinement of the Smithsonian's walls, the institution has published the Smithsonian Series of books, in which the romance of the Institution is vividly portrayed by its scholars. The series discusses: The Sun and the Welfare of Man; Minerals from Earth and Sky; North American Indians; Insects and Their Ways and Means of Living; Man from the Farthest Past; birds, fish plants, great inventions. The books will be micro-filmed, sealed in a crypt to remain until 8113 A.D. so that the record will be available for posterity.

COST ESTIMATES have been prepared for a plant to make 12,000,000 cu ft of water gas a day by passing a suspension of pulverized coal and steam through incandescent tubes. In tests at Battelle, 700 cu ft of water gas an hour was produced in a single tube 9 ft long and 8 in. in diameter, heated to 1850 F. Evidence was presented that a steel of 31 per cent chromium content might be operated at 2100 F, which would double the gas-making capacity.

GRAY IRON PRESSURE CASTINGS suitable for temperatures up to 650 F, with strength of 40,000 psi, are being proposed in a new preliminary ASTM specification. They are made possible by "inoculation," a process developed during the war when the demand for steel castings exceeded steel foundry capacity. In this process, inoculants containing alloys such as nickel, chromium, manganese in addition to silico, calcium and aluminum are used.

BEFORE hundreds of members of the New York Zoological Society gathered at the Waldorf-Astoria for their Fiftieth Annual Meeting, a glass-sided water-filled tank about six feet long, with conducting screens of electrodes at both ends, contained two *electrophorus electricus (linnaeus)*—just plain electric eels to youse. These two electric eels wrote their shocking story in electronic terms on a large screen for all to see. By means of the latest Du Mont oscillograph provided with a special projection lens, the "radar" or exploratory impulses as well as the real lethal shocks were shown in impressive wave forms, ending for all time the age-long mystery of the famous electric eel.

TRY TO MAKE your product as good as it would have been today if there'd been no war. Don't forget that during the war many new materials of construction have been tried. Some of them were just stop-gaps, substitutes, but a lot of them turned out to be better than the original materials. Better check up on them and use them where they'll help.

MOTOR BUSES of the future will possess, among other attributes, pressurized, air-conditioned passenger compartments; individual radio sets; circulating ice water; retiring rooms; inside destination signs operated by push-button; polaroid windows; turbine-electric drive; speeds of 100 miles per hour on suitable highways. This future vehicle was pictured by L. H. Smith before the SAE annual meeting. He suggested that atomic energy ultimately might be used for propulsion, but for the immediate future directed attention to turbine-electric drive combinations operating on two fluids mixed in transit to comprise safe and powerful fuel.

DON'T DO IT! 'Tain't for it! If you're tempted to refill fire extinguishers in your plant with commercial grade carbon tetrachloride — STOP, LOOK, AND LISTEN to the warnings of the Associated Factory Mutual Fire Insurance Companies and the American Society of Safety Engineers as reported in No. 33 of *Firefax*. The carbon tetrachloride may cause severe corrosion in brass parts of the fire extinguishers so that they won't work when required. The extinguisher and its proper liquid are tested and approved as a unit. When carbon tetrachloride is used by the manufacturer, it meets Federal and Underwriter's Laboratories specifications. But if it contains water and other impurities it will eat holes in brass extinguisher parts, corrode the shell so it will be very thin—and the extinguisher just goes Pouf! in your hands when you try to use it.

DISPOSING of war surplus goods presents problems as complex as the creation of the surplus did. Who does this work, what materials they must deal with, what to do with plants and facilities, equipment, food, maritime property, aircraft equipment, territorial property and overseas operations are discussed in detail in The Liquidation of War Surpluses, a quarterly progress report to the Congress by the Surplus Property Administration.

TROUBLE BEGINS TO SHOW UP ABOUT HERE

A turbine oil that is not specially refined and fortified begins to suffer from the ever-increasing effects of its own breakdown. The products of oil oxidation serve to speed the oxidation of *more and more* oil. No wonder ordinary lube oil quality drops rapidly!

Why SHELL TURBO OILS counteract oxidation and rusting in your turbine

SHELL TURBO OILS show little or no oxidation and have completely prevented rust in turbines after years of service in industrial, marine, and public utility installations.

This means that the life of the lubricating oil has been extended far beyond what was thought possible a few years ago. It has been accomplished by four important steps in the refining process:

1. Scientific selection of crude stocks.
2. Special refining that removes all readily oxidized compounds. This also results in better demulsibility.
3. Shell fortifies Turbo Oil with an effective anti-oxidant. Again, by retarding oxidation, better demulsibility is retained.
4. Shell fortifies Turbo Oil with a rust preventive. The elimination of rust is vital to the oil as well as the machine.

The Shell Lubrication Engineer will give you sound advice about your turbine lubricating problems.

For literature about turbine lubrication and turbine cleaning procedures, write to Shell Oil Company, Incorporated, 50 West 50th Street, New York 20, New York; or 100 Bush Street, San Francisco 6, California.

SHELL

SHELL TURBO OIL

"There's an

YARWAY

1 Floatless

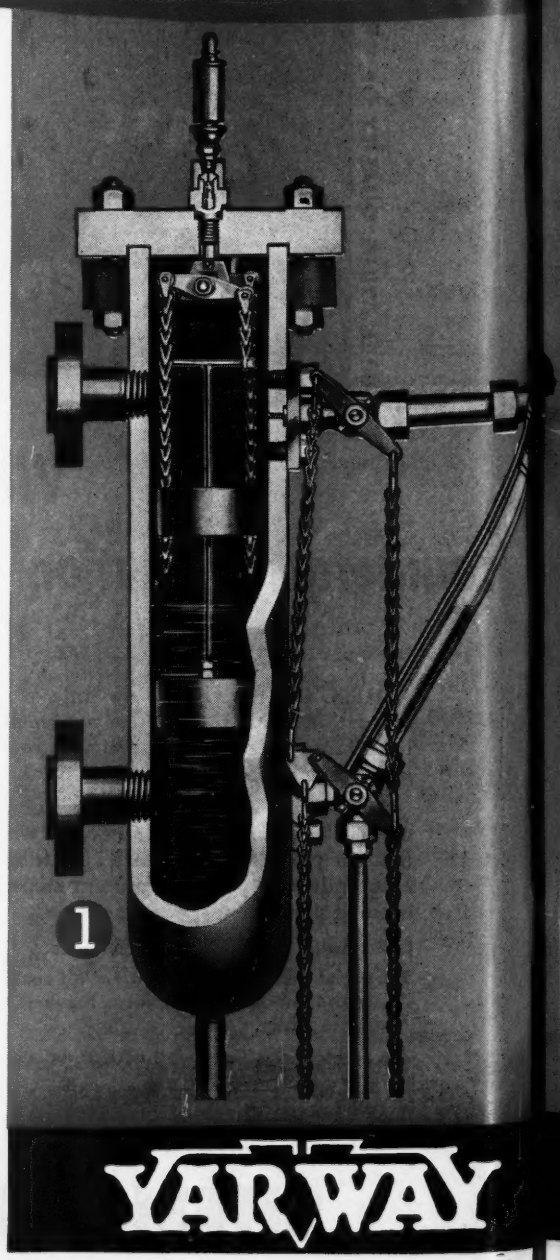
Yarway's Hi-Lo Alarm Water Column has an alarm mechanism that is simple . . . dependable . . . unique. Solid weights operate the whistle alarm. The principle employed is that heavy objects submerged or partly submerged in water are buoyed up by a force equal to the weight of the water they displace. Any dangerous change in water level causes the weights to open or close a needle valve through which steam is admitted to the alarm whistle. The alarm is always dependable . . . the weights can never become waterlogged. Yarway Column shown has Sesure Inclined Gage for pressures up to 400 psi. Flat Glass Gages furnished for pressures to 1500 psi. Ask for Bulletin WG-1810.

2 Remote

Yarway's Remote Water Level Indicator brings overhead boiler water level readings right down to eye level, on the instrument panel or other convenient place, on a brilliantly lighted red and green scale. Indication is *positive* and *instant* because the instrument is operated by the boiler water itself. Shows boiler water level beyond the range of overhead gage, and always indicates high or low—even when full or empty overhead gages look the same. Suitable for all pressures to 1500 psi. Ask for Bulletin WG-1820.

3 Seatless

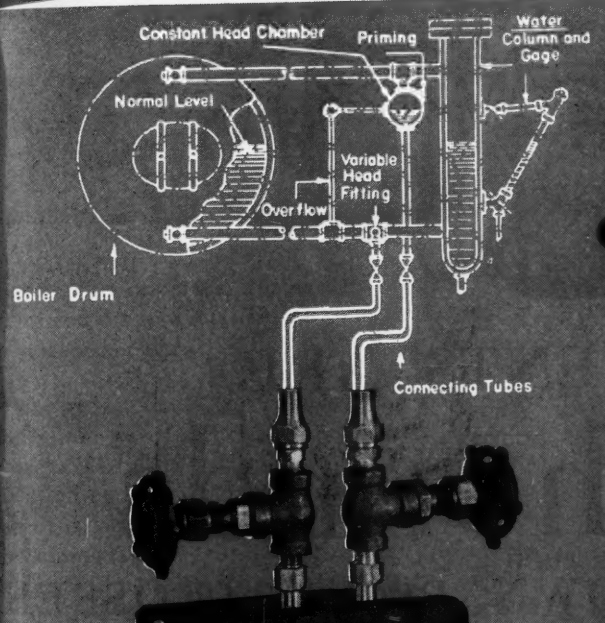
Yarway's famous Seatless Blow-Off Valve eliminates one of the commonest sources of trouble and expense in boiler blowdown service. *There is no seat* to score, wear and clog with mud, dirt and scale. Balanced sliding nitralloy plunger and straight through flow make operation easy. Today this valve is "standard" in over 12,000 boiler plants. Suitable for all pressures up to 2500 psi. Ask for Bulletin B-424 (to 400 psi), Bulletin B-432 for higher pressures.

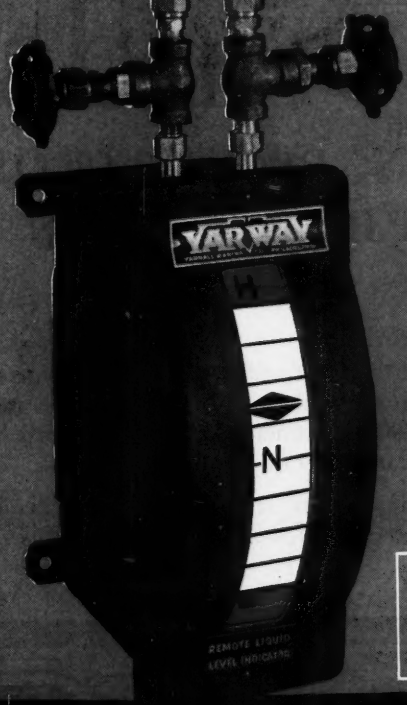


YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.

Engineering Reason"

BOILER TRIM





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3

See Yarway Boiler Trim "in action" in the 30-minute color motion picture, "There Is An Engineering Reason." Hear Lowell Thomas describe their principles and operation. Now available without charge for group showings. Write today.

STEAM PLANT EQUIPMENT

INSTRUMENTS ARE Bloodhounds

FOR TRACKING DOWN POWER LOSSES THAT HAMPER PRODUCTION

★

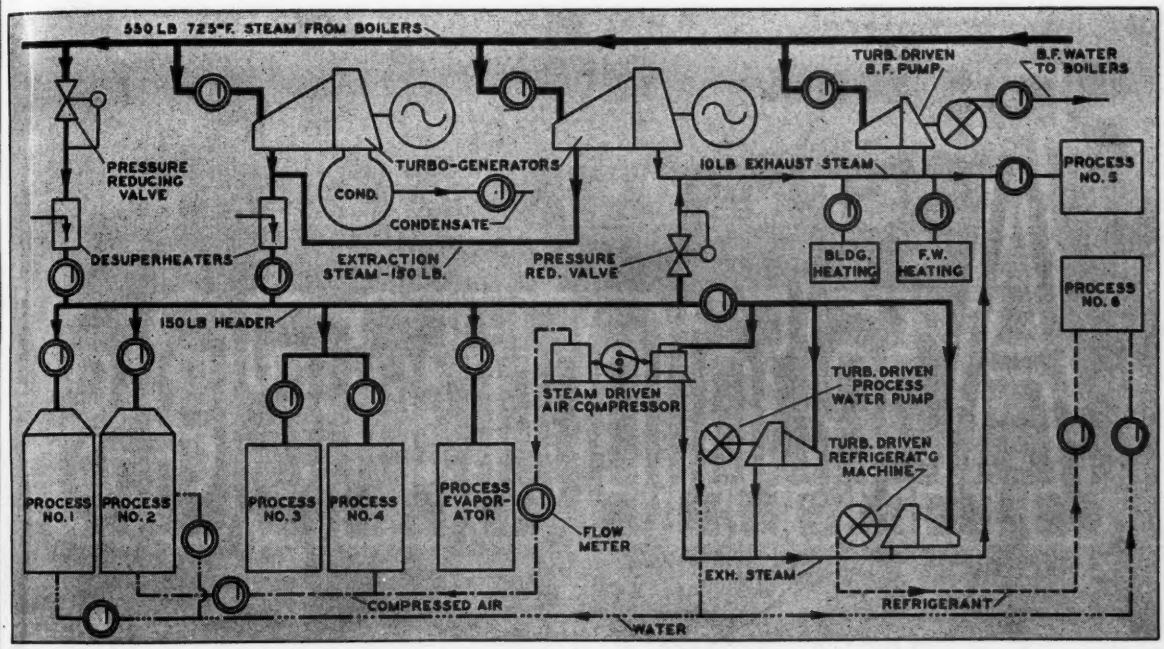
To meet your increased steam demand, you are stretching the capacity of your boilers through shrewd operation—you are generating 11 lbs. of steam for every pound of coal you burn. Great!

But how much are you gaining if the rest of your plant wastes the steam?

All the effort and engineering skill you are expending to stretch your boiler capacity to meet present emergency conditions can be nullified by wasteful use of the steam produced.

Instruments are the bloodhounds that track down these steam losses. Anything that *reduces* the power

REPUBLIC
INSTRUMENTS
AND CONTROLS



consumption of pumps, compressors, dryers or other steam consuming units *increases* the *effective* capacity of your power plant.

The only accurate and reliable check on the use and abuse of steam, water, compressed air and other power plant services is to install flow meters (and, when needed, pressure and temperature recorders) on the supply lines to the various power consuming units. Only through an instrument installation of this type can operator and department head alike be provided with the data that will enable them to immediately locate and correct faulty or wasteful operating conditions.

MEASURING VERSUS GUESSING

The accompanying diagram shows a typical distribution meter system that provides a continuous picture of the consumption of power plant services by departments and processes, individually and collectively.

Total amount of steam consumed by prime movers and auxiliaries is measured, as well as the amounts supplied by extraction and exhaust to the various pressure systems serving process and heating loads. Actual consumption of steam, water, compressed air and refrigerant by individual departments, and even individual processes, is accurately and continuously metered instead of being merely estimated.

SPOTTING THE LOSSES

Methods of reducing this consumption can be quickly spotted by studying the peculiarities of operation revealed by the graphic records. These, in conjunction with process production figures, will indicate when and why a department or process uses more of a power plant service than necessary.

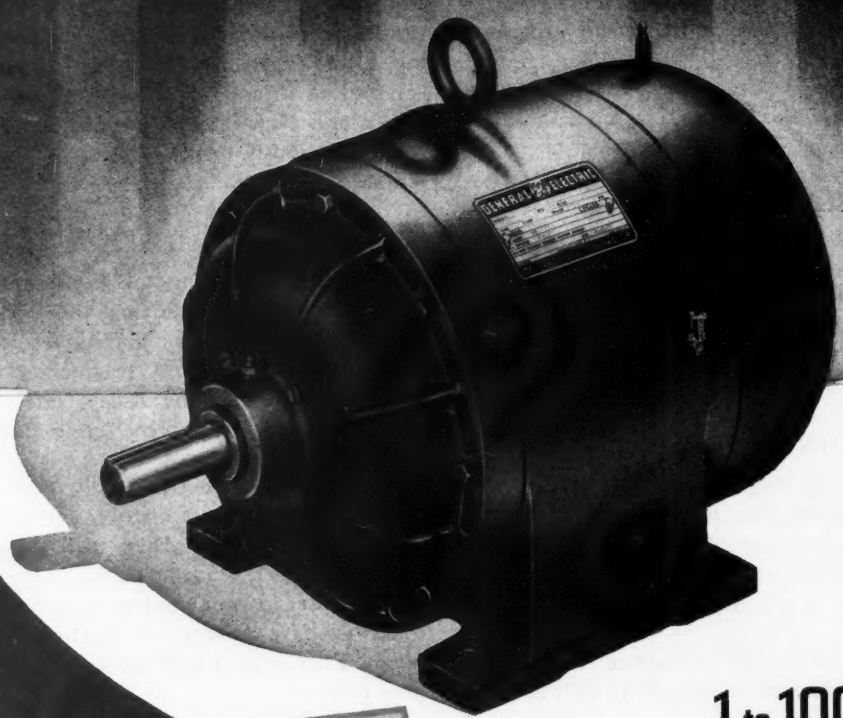
Republic engineers will gladly consult with your own engineers on any distribution metering problems you may have. They will show you how Republic meters can help you eliminate power service losses in your production departments. Ask today to have a Republic engineer call at your plant. Your request will involve no obligation on your part.

Republic Flow Meters Co.

2224 Diversey Parkway • Chicago 47, Illinois

GENERAL ELECTRIC

Announces



1 to 1000 hp

COMPLETE ENCLOSURE FOR PROTECTION AGAINST DIRT, DUST, AND WEATHER

NEW

Totally Enclosed

TRI-CLAD MOTORS

REG. U.S. PAT. OFF.

In 1940, G.E. introduced the Tri-Clad open motor—with emphasis on the feature that industry wanted most in a motor, *protection.* Since then, more Tri-Clads have gone into service than any other integral-horsepower motor.

Today, we are ready with a new line of Tri-Clad motors—*totally enclosed, fan-cooled motors*—built on Tri-Clad design principles in both standard and explosion-proof types.

We believe that these are industry's most dependable motors. They are designed specifically for use in many adverse atmospheres—in iron dust, outdoors, in hazardous areas, and chemical atmospheres. Their scope of application is as wide as the field of industrial motor use. Safeguarded against most sources of motor damage, their longer life and lower maintenance will make them economical motors for use on almost every job. *General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

TRI-CLAD MOTORS

ANOTHER USE OF

... in Central Station Unit

The convection section of this public utility steam generator introduces a new application of the Foster Wheeler extended-surface natural-circulation waste heat boiler principle for central station units. The design provides convection steam generating surface in less space than the usual bare tube convection section. Further, when extensive convection surfaces are necessary, this arrangement eliminates the usual lower drum and sometimes an additional upper drum. Baffles and baffle maintenance are also eliminated.

The waste heat convection steam generating section consists of a number of parallel units, each having a small number of either bare or extended-surface elements in series. Each unit is supplied at the bottom with water from the boiler circulation, and has its own long, separate, heated riser to the steam drum. The available circulating head is very large and the circulation rate in each unit is as high, if not higher, than in the tubes of the radiant section. Gases entering the bottom of the waste heat section have been cooled in the radiant section to temperatures well below the slagging point so that the surface can be kept clean with ordinary soot blowers.

Wide experience in the design and manufacture of thousands of extended-surface elements for service under comparable—or more severe—temperature conditions in natural-circulation waste heat boilers, economizers, and superheaters, has paved the way for this new application.

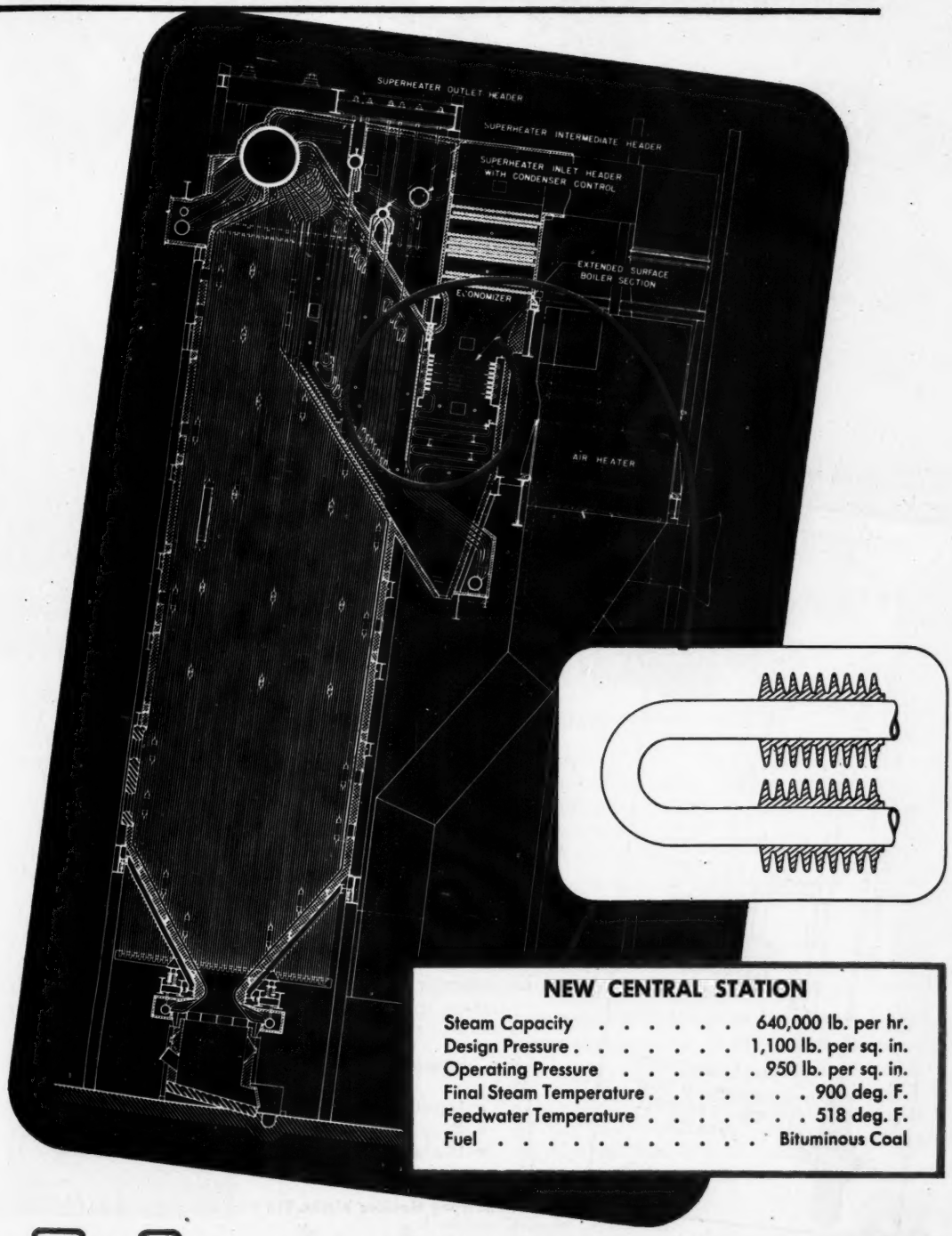
The unit will be served by two Foster Wheeler ball mill pulverizers firing bituminous coal. In addition, *eight* Foster Wheeler ball mills serve *four* boilers of other manufacture in the stations of this utility.

Foster Wheeler progressive research and engineering have answered many difficult problems of steam generator design—bulletins describing units for varied service are available on request.

FOSTER WHEELER CORPORATION · *165 Broadway, New York 6, N. Y.*

FW FOSTER

EXTENDED SURFACE



NEW CENTRAL STATION

Steam Capacity	640,000 lb. per hr.
Design Pressure	1,100 lb. per sq. in.
Operating Pressure	950 lb. per sq. in.
Final Steam Temperature	900 deg. F.
Feedwater Temperature	518 deg. F.
Fuel	Bituminous Coal

WHEELER FW

HOW TO TRAP

STEAM PURIFIERS AND SEPARATORS

One of a series of advertisements, each discussing trapping practice on a different class of equipment.

* Piston-operated compound trap with capacities to 300,000 lbs. per hr.

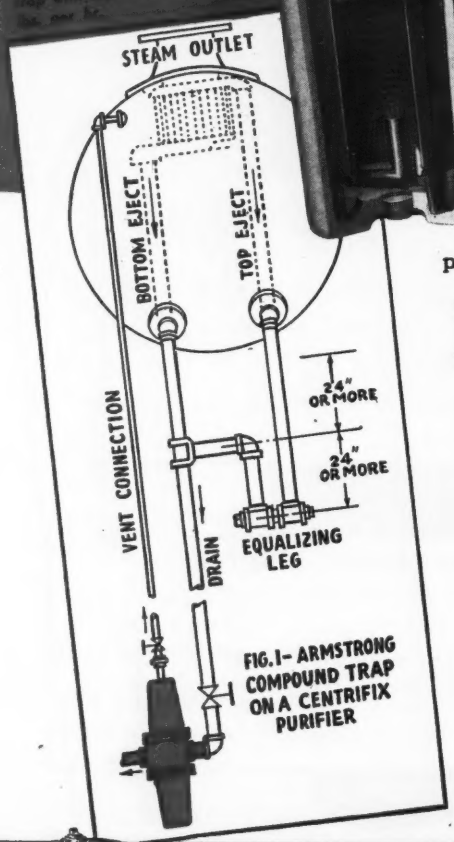


FIG. 1 – ARMSTRONG COMPOUND TRAP ON A CENTRIFIX PURIFIER

to eliminate dangerous slugs of water by quick, complete drainage

Where load and water conditions cause foaming and priming at the boiler, Armstrong traps are a logical choice for draining the necessary purifiers and separators. Here's why:

They prevent slugs of water from passing beyond the purifier and damaging expensive steam-using units.

They quickly drain purifiers and separators which have small water-storage capacities.

Armstrong trapping of purifiers and separators outdates old-fashioned gravity drainage. Depending on capacities required, Armstrong offers either standard traps or piston-operated compound traps with semi-steel or forged steel bodies for this service.

Send for a copy of Catalog H for valuable information on separator and purifier drainage, with charts, data and tips on trapping problems encountered by engineers everywhere.

When Trapping Purifiers or Separators, remember to:

- **Install trap below purifier.**
- **Keep drain line to trap free from bends.**
- **Use a vent line as shown for quick opening.**

Armstrong Machine Works, 810 Maple St., Three Rivers, Mich

ARMSTRONG STEAM TRAPS

Over a Million in Use...For Power...Process...Heating

...and its place—in this particular case—is in the steam lines of the air conditioning and heating plant of one of the largest department stores in Washington, D. C. Installed by the Armstrong Cork Company, K&M Distributor, "Featherweight" is once again demonstrating that it is the most efficient of the moulded-type insulation materials.

Designed for pipe surfaces carrying temperatures up to 600° F., it is extremely light in weight, absolutely fireproof, and sufficiently strong mechanically to withstand all ordinary usage ... and then some. "Featherweight" 85% Magnesia has even emerged unscathed from the usually damaging effects of floods or trips to Davy Jones' locker!

In factories, ships, refineries ... K&M "Featherweight" 85% Magnesia has always led the way in keeping heat in its place. Once installed in YOUR plant, it will banish your insulation problems for good. Why not write us for further details?

Nature made Asbestos...

Keasbey & Mattison has been making it serve mankind since 1873

K&M best in asbestos

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

"You don't have to be no watchmaker to work on Hagan Control"

Back in 1936, we installed Hagan Automatic Combustion Control on the first two high-pressure boilers in a large eastern plant.

Three years later, another boiler was installed, and again Hagan Control was specified.

Then, deciding that they should have first-hand knowledge of the performance of other control systems, the engineers installed a well-known instrument type of control on the next boiler, in the low pressure section of the same plant.

Now, one more boiler is going in—and Hagan Control is again specified. The veteran boiler room superintendent put his reasons into a single emphatic statement—"You don't have to be no watchmaker to work on Hagan Control."

The same simplicity of design that makes it possible for any competent mechanic to attend to the maintenance of Hagan Control is also largely responsible for its ruggedness and dependability, and for its continued high accuracy over long periods of time.

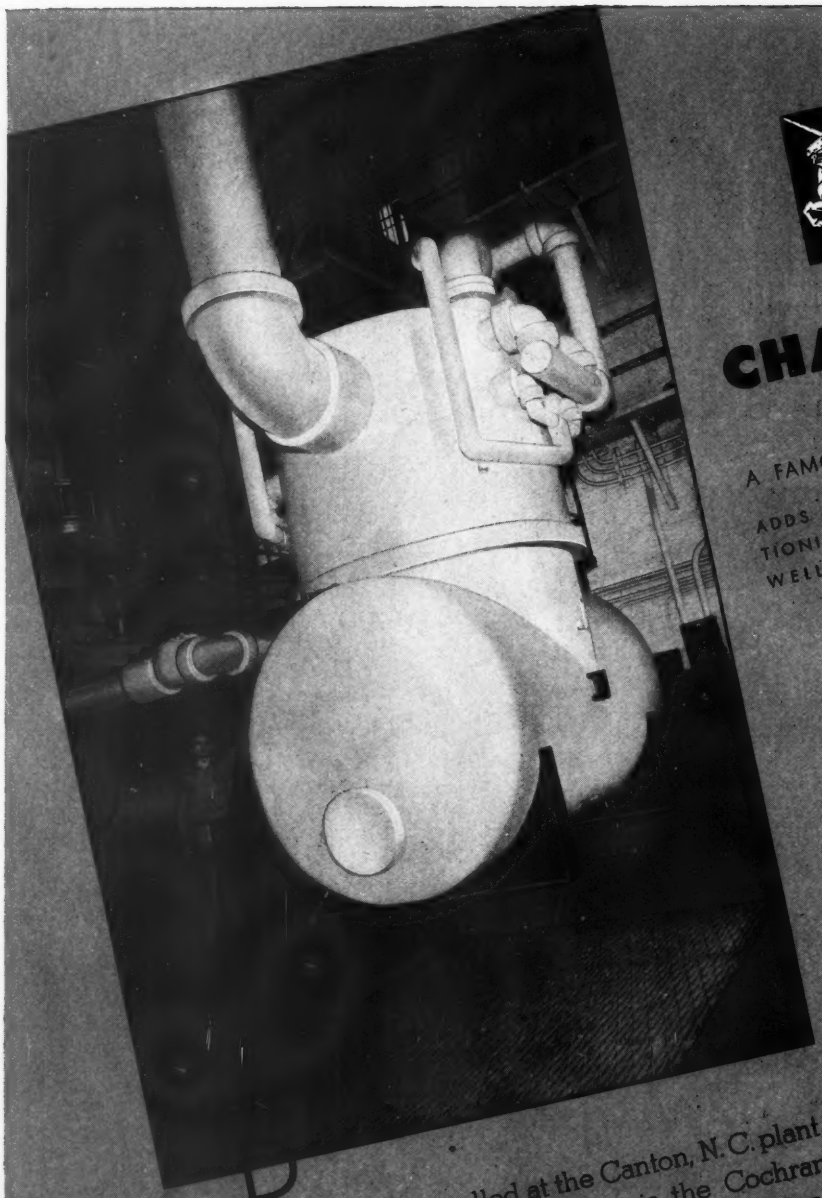
Hagan Control will function efficiently with any size, type or make of boiler. The services of our engineers are available, without charge or obligation, to aid in planning boiler installations.

HAGAN
HALL
BUROMIN
CALGON

HAGAN CORPORATION, HAGAN BUILDING, PITTSBURGH 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader



CHAMPION

A FAMOUS NAME IN PAPER

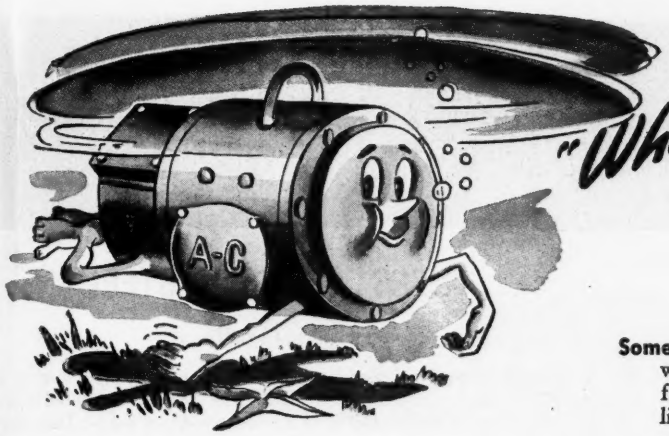
ADDS ANOTHER WATER-CONDITIONING UNIT OF A SIMILARLY WELL-KNOWN NAME . . . . .

. . . and hundreds of other Cochrane Deaerators and Hot Process Water Softeners are used by the Pulp and Paper Industry.

Recently installed at the Canton, N. C. plant of Champion Paper & Fibre Company is the Cochrane Deaerator, of 400,000 lbs. per hour capacity, shown above. This unit, mounted on a storage tank, works in parallel with a 600,000 lbs/hr. Cochrane Deaerator installed 15 years ago. Other Cochrane water-conditioning units in Champion plants include a 225,000 lbs./hr. Deaerator at Houston, Texas, and a 24,000 GPH Hot Process Softener at Hamilton, O.

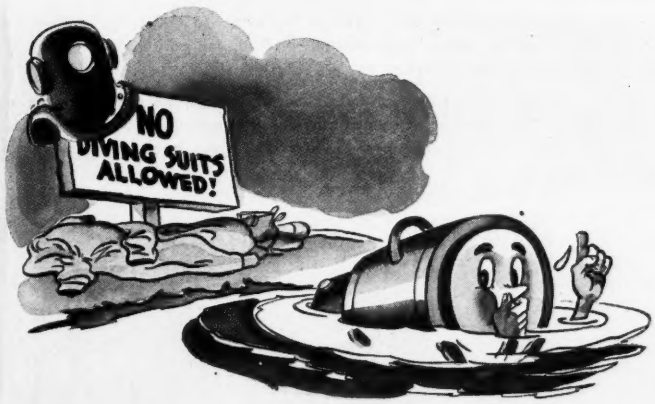
COCHRANE

COCHRANE CORPORATION, 17th & Allegheny Ave., PHILADELPHIA 32, PA.



"What! Build a Motor to Run Underwater for 90 Days?"

Some said "Impossible!" But the Navy insisted, "We want a motor that likes water so well it'll run in 25 feet of it for 90 days. What's more—it's got to be lighter, more compact than standard motors."



No diving suits allowed! Biggest problem was water-proof, pressure-proof casings. Cast-iron wouldn't do — too porous. So we turned to fabricated steel — tough, durable — and lightweight too!

Then we found that fabricated parts could be successfully welded together to assure water-tightness. For proper magnetic characteristics, we decided to use field yokes of one-inch rolled steel.

Things look better! We reinforced end-housings, double-checked insulation, made sure exposed parts were leak-proof. Nothing left to do but put our baby in the test-tank, check it regularly, and hold our breath.

90 days later—we took a good look. Motor still running and not a drop of water inside! That called for a short cheer and wide smiles all around. Mass production of these motors followed.

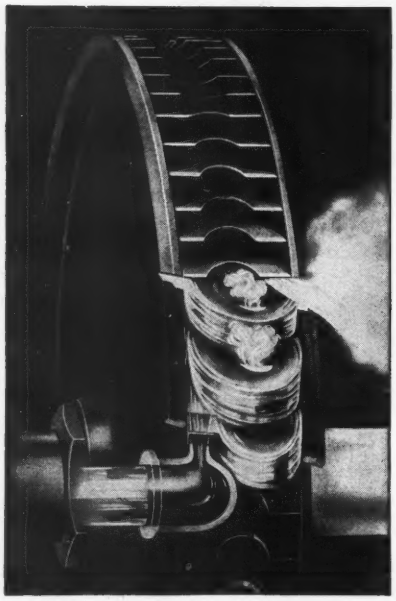
There's a Moral: Every time Allis-Chalmers engineering solves *special* motor problems, we discover new ways to build better standard motors for you. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1927

Wait 'til you see the NEW

ALLIS-CHALMERS MOTORS!

The TERRY



Action of steam in Terry Solid Wheel Turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket, in which its direction is reversed 180°. The steam is caught in a stationary reversing chamber and returned to the wheel. This process is repeated several times.

USES A SOLID STEEL ROTOR

The rotor of the Terry Wheel Turbine is made from a single forging of s composition steel. The semi-circular buckets or pockets are milled from the metal. The steps in the machining of a wheel are shown below. There are no to become loose or work out.

The power-producing action of the steam in the wheel buckets takes entirely on the curved surface at the back of the bucket and therefore close clearance is not necessary.

As the only function of these blades is to form a series of pockets, wear blades is of little consequence and does not materially affect the horse po efficiency. The important part of the bucket is the back or bottom, which is forging.

FORGING — ROUGH TURNED

THE TERRY STEAM TURBINE CO.

Wheel Turbine

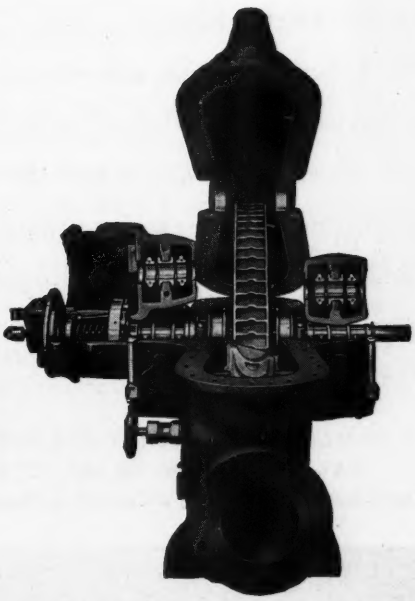
FINISHED WHEEL

SECOND MILLING CUT

FIRST MILLING CUT

SMOOTH TURNED

STEPS IN THE MACHINING OF A TERRY TURBINE WHEEL



Typical Terry Solid Wheel Turbine with cover and bearing caps raised. Note the ruggedness and the accessibility of all parts. Units of this type are used to drive boiler feed pumps, generators, and all types of power plant equipment. Built in sizes from 5 H.P. to 2000 H.P.

FOR FULL DETAILS ASK FOR BULLETIN S-116

T-1156

TERRY SQUARE - HARTFORD, CONN.

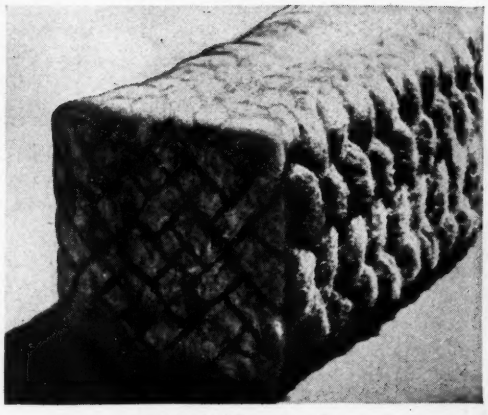
An Entirely Different BRAIDED PACKING

The strands of GARLOCK *Lattice-Braid* packing are braided *through and through* in an entirely new and different way from ordinary braided packings. All strands are lattice-linked together into one structural unit.

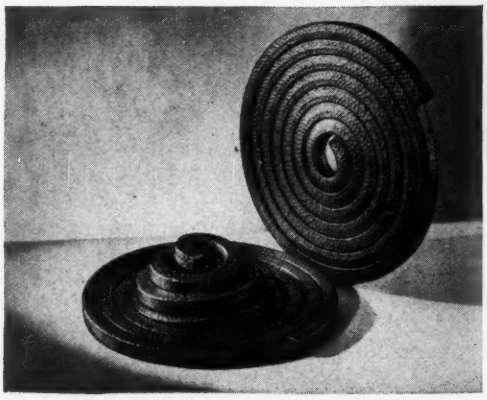
Result: (1) *unusual flexibility* and semi-automatic pressure action which enables the packing to function more efficiently; (2) *longer life*, because the strands hold together even when the packing is worn far beyond the limits of wear of ordinary braided packings.

GARLOCK *Lattice-Braid* is furnished in several styles for various types of service.

THE GARLOCK PACKING COMPANY,
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.



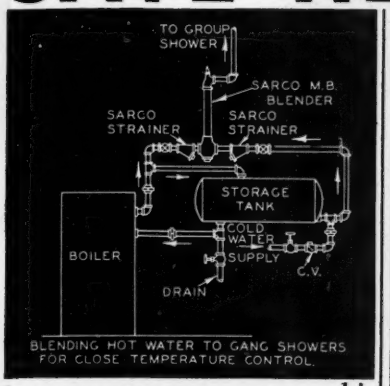
Patented Construction



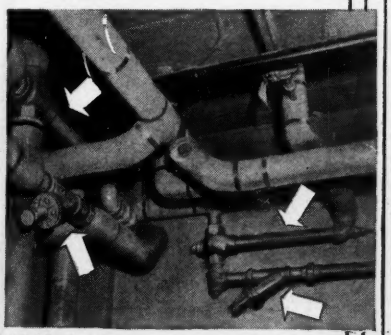
Garlock 731 Lattice-Braid Coil

GARLOCK *Lattice-Braid* PACKING

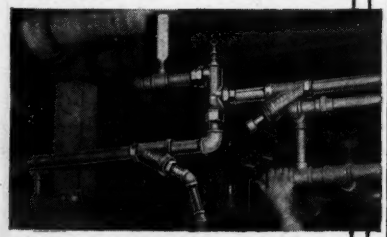
SAVE HEAT AND WATER



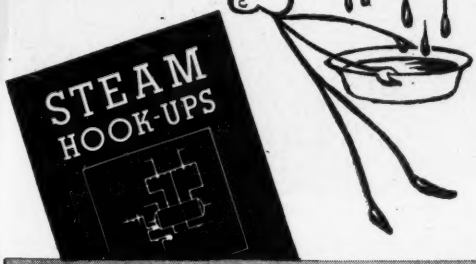
MB blenders on gang showers



MB blender for process water



DB blender for apartment hot water line



SARCO MB BLENDER

When you save hot water, you save three ways: with less water and heat, you can render a better service in process, shower or rinse tank operations. The Sarco Blender at the right is one of three distinctly different methods of Sarco hot water control.

It is a simple, sturdy thermostatic mixing valve. By adding cold to hot water available, it automatically provides blended water at any temperature for which it has been set by the user.

IN COMMERCIAL BUILDINGS

Hot water complaints from tenants and employees are the dreaded daily routine of the engineer who is not protected by Sarco Controls. The Sarco Blender shown at the left eliminated all complaints.

The Sarco Blender is used also to regulate flow of cooling water in jackets of internal combustion engines or of brine in cooling coils.

Available in sizes ½ to 4", for pressures up to 150 lbs., 0° to 200° F. See Catalog No. 800.

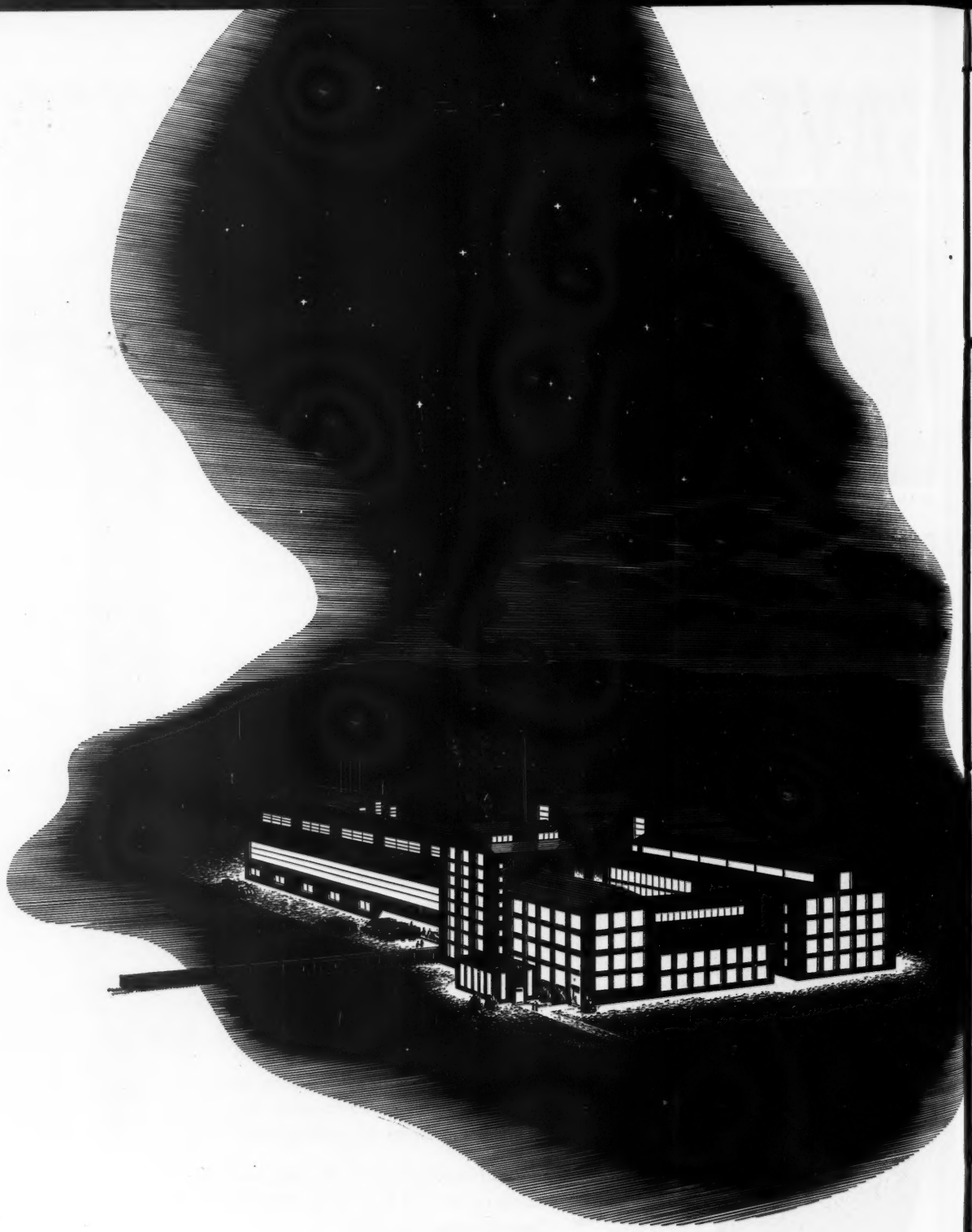
32

SARCO COMPANY, INC.
475 FIFTH AVENUE
NEW YORK 17, N. Y.

Represented in Principal Cities

SARCO Saves Steam

SARCO CANADA, LTD., 85 Richmond Street, West, TORONTO, ONTARIO



HALL SYSTEM *of Boiler Water Conditioning*

The Situation

MAKE-UP DEMAND——37,000 GALLONS PER HOUR

CAPACITY OF FEEDWATER TREATING PLANT——24,000 GALLONS PER HOUR

The Problem

TO AVERT POSSIBLE SHUTDOWN WHILE CONTINUING TO OPERATE AT EXTREMELY HIGH OVERLOAD.

For various reasons, it was necessary for this Indiana plant to carry a very high overload for a period of several weeks. Average hourly make-up requirement during this period was 31,000 gallons per hour; peak demand 37,000 gallons per hour. Yet the softener capacity was only 24,000 gallons per hour, and the filter capacity with all units in operation, only 20,000 gallons per hour. The condensate compartment of the softener could not handle all returns; it flooded over into the reaction chamber, thus adding to the difficulties of softener operation and chemical control.

Naturally there was trouble. There was a tremendous amount of suspended matter in the softener effluent; filters were not only inadequate, but their condition was none too good, and hardness of the filter effluent was much higher than normal. Phosphate consumption was excessive and despite maximum blowdown, boiler water was highly alkaline and the boilers were carrying over.

The task of the Hall engineer was to devise ways of correcting these conditions, at least temporarily, while permitting the plant to continue uninterrupted operation.

These measures were taken:

1. All boilers were blown as heavily as possible throughout the entire 24 hours of each day.

2. Phosphate feed was tripled, since tests had shown no phosphate reserve in any unit.

3. Installation of two new filters, secured earlier in the year, was rushed, so as to bring filter capacity up to softener capacity.

4. The condensate compartment was partially bypassed, by means of a line direct to feed pump suction, thus reducing the overload enough to prevent flooding of the reaction chamber.

The Hall engineer spent seven hectic days on this job—but the plant was kept in full operation. The period of heavy overload ended with no boiler outage. Additional changes were then started, designed to prevent trouble if there should again be a period of such excessive overload.

Hall service engineers are proud of their ability to meet emergencies like this—but they are still more proud of the fact that the great majority of Hall-serviced plants operate day after day and year after year *without* any serious boiler water difficulties.

Every plant that generates its own steam can profitably use Hall service. We will be glad to send you full information.

HALL LABORATORIES, INC., HAGAN BUILDING, PITTSBURGH 30, PA.
(A subsidiary of Hagan Corporation)

HAGAN
HALL
BUROMIN
CALGON

GOOD control does not come in packages . . . but it is an integral part of the Nalco System of water treatment. Every plant where Nalco is in use has a routine control procedure, recommended as a result of a Nalco Engineer's survey of plant water and operating conditions. Nalco records show that the right chemical treatment, plus good control invariably pays off in lower fuel costs, longer on-line operation, and diminishing maintenance charges. Write today for details on getting complete scientific water treatment for your plant.

NATIONAL ALUMINATE CORPORATION
6224 West 66th Place, Chicago 38, Illinois
Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Ave., Toronto, Ont.

Nalco

THE SCIENTIFIC WATER TREATMENT FOR ALL INDUSTRY

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILERS, AUXILIARIES

1 **Water Heating Rating Book**—This data book presents 15 pages of water heater capacity ratings per hour for 11 different sizes of water heaters. The first table covers the conditions with a 20 F temperature rise from 50 to 70 F, the second covers conditions under a 30 F temperature rise from 50 to 80 F. This ratio of rise in the tables continues and the final table is for a 150 F rise from 50 to 200 F. The last table in the book covers the flow of steam through pipes. The tables are arranged for easy reference and the book is perforated for loose-leaf filing. Marion Machine, Foundry and Supply Co.

2 **Soot Blowers**—This 30-pg. book goes deeply into the whole subject of soot blowers. It talks about soot blowers in general; what causes soot, a description and operation summary of the company's soot blower; elements . . . materials and specifications; steam consumption tables; boiler efficiency tables; tables of feedwater temperature and steam flow; installations shown in boiler sections; other designs of soot blowers for water tube boilers, 2. for fire tube and hrt boilers. Marion Machine, Foundry & Supply Co.

3 **Tube Cleaners**—Water driven cleaners for straight and bent tubes are described in this four-page bulletin. Exploded and sectional views of the cleaner are presented and features are pointed out. Complete tables show recommended sizes of cleaners for various size tubes, both straight and curved. Elliott Company.

4 **Steam Generator Case Study**—"Facts and Figures" is the title of a booklet covering the case history of an installation of a steam generator in a prominent dairy. The booklet shows how the unit handled the varying load requirements for high pressure process steam and low pressure heating steam by furnishing steam at a steady pressure regardless of the demand. Cross sections of the steam generator and graphic presentations of its advantages are given. One of the features is a series of fuel comparison charts with which the costs of various fuels are compared. York-Shipley, Inc.

5 **High Temperature Cement**—A 4-pg. folder on this company's Fyre-Mortar high temperature cement has been announced. The bulletin tells about the bonding strength, stability, working characteristics, etc., of the material. Quigley Company.

6 **Materials Handling** — Modern materials handling machinery is covered in an 8-pg. booklet issued recently. The featured product is a new car shakeout. By means of illustrations and text the booklet shows how hopper bottom cars are shaken out "broom clean" in 1½ to 7 minutes by only two men. Another part of the bulletin shows how easy and simple is the job of putting the shakeout in position. Robins Conveyors, Inc.

7 **Boilers**—Bulletin No. 110, describing this manufacturer's "Perfect Balance" boilers, is a 4-pg. item and is designed to present capacity tables, dimensioned drawings and a full page cut-away wash drawing of the unit. John Phillips Badenhausen, Inc.

8 **Self-Cleaning Water Strainer** — This new 4-page circular covers the company's self-cleaning water strainer; it gives a description of the equipment, the capacities, the straining media and other engineering data covering the latest design. S. P. Kinney Engineers, Inc.

9 **Central Heating, Steam Distibution**—A case study of the Firestone Industrial Community at Akron, Ohio, in relationship to the central heating system installed is the subject of this new 8-page bulletin. Layouts of the piping system are included as are photos of the plant, the installation of the system and features of the steam generation and control. The Ric-Wil Company.

10 **"Heat Transfer Apparatus for Power Plants"**—That's the title of this Bulletin 1250 issued recently. There are eight pages and each page is filled with neatly arranged pieces of heat transfer equipment with brief descriptions accompanying each of the units. Griscom-Russell Co.

11 **Furnace Walls and Arches**—Sectionally supported, ventilated or insulated furnace walls and arches are described in this new 16-page data book. Methods of repair and installation are dealt with in detail and various types of wall construction are shown in diagrams. Drawings show sections through furnace walls and they are also used to illustrate the hanging of the arches and walls. Sections of walls are also shown in photos. Furnace Economy Co.

12 **Data on Barometric Condensers**—Bulletin No. 4509, "Parallel Flow Barometric Condensers" describes the use of Parallel Flow type barometric condensers as intercondensers and aftercondensers in connection with steam jet ejectors. Engineering data covers duty, temperature rise, terminal difference, condensing water requirements and a table for selecting the correct size unit. Ross Heater & Mfg. Co.

ELECTRICAL

13 **Power Transformers**—This company has just released a strikingly illustrated booklet giving an unusually comprehensive overall picture of its power transformer. Divided into three sections, the booket tells of the evolution of the modern power transformer; shows photographically how shell-type transformers are built, from the winding of the circular coils to the time the completed unit leaves the shops; and shows installations of transformers. The booklet is of unusual size—15⅝ by 10⅞ in.—and is folded in half for convenience in filing. The Allis-Chalmers Mfg. Co.

14 **Infra-Red In Industry**—Reconversion tips, inside data on war know-how which may prove valuable now, description of a better way to heat process, and reports on how others do it are contained in a new 12-page bulletin. Case studies of what various manufacturers did in the field of infra-red baking, drying, dehydrating and preheating are covered. Factors in an infra-red installation are discussed and applications and reasons for using it are also covered. The booklet is well illustrated. The Fostoria Pressed Steel Corp.

15 **Electric Eye Smoke Indicators and Recorders**—There are four pages of information and photos on the design advantages of eye and light source units. Dimensioned drawings increase the usefulness of the bulletin. Brooke Engineering Co., Inc.

16 **Intraplant Communication** — Intraplant communication is completely covered in a group of folders issued recently. The manufacturer's Operadio Soundcaster, Plant Broadcaster and Flexiphone intercommunication systems are dealt with thoroughly. Typical installations with discussions of the outstanding features of each is included. Principles of operation and details of construction are given and photos illustrate each feature mentioned. Operadio Manufacturing Co.

VALVES, FITTINGS

17 **Relief Valve Handbook** — Here is a new, 28-page relief valve booklet that covers the company's product from A to Z. The valve's numerous applications in relief of steam, air, gas, gasoline and oil vapors, water, etc. are carefully brought out and its adaptability to other services are cited. Of special interest and usefulness is the revised "Sizing Data on Relief Valves" which includes many capacity and pressure rise tables which are unusually convenient for selection of the proper size relief valve. This new publication is well illustrated. Cochrane Corp.

18 **Book on Pipe Threads**—"What Dryseal Pipe Threads Are and How They Work" is the title of this new booklet. Complete drawings and tables of measurements accompany the sections on "What They Are" and "How They Work." The reasons why this company's fittings will, in the future, be threaded with this type of thread is also explained. The Weatherhead Co.

19 **Tube Couplings and Valves**—The 8-page catalog, titled "Fluid Power Engineering," tells about the tube couplings, valves, tools and tube fabrication of this company. The first part of the booklet considers fluid power . . . what you can do with it . . . what it is . . . and what are its unique advantages. Pictures and descriptions of the various products follow. The Parker Appliance Co.

20 **Corrosion Resistant Valves**—Two bulletins, both of them on corrosion resistant valves have just been issued. One of them, a technical information bulletin covers the mechanical properties, analysis range, applications, advantages and sizes and specifications of the valves. The other is devoted to a photographic display of the installation of the valves. Alloy Steel Products Co.

21 **Stainless Steel Bellows Data Book**—This booklet contains cross sectional views and important up-to-date information concerning the use of these bellows as equalizers, compensators, expansion joints, flexible connectors, for flow control, vapor and steam traps, thermostatic instruments, electrical controls and other industrial applications. Chicago Metal Hose Corp.

22 **Data On Unions**—This 14-page booklet tells how this company's unions are made, pointing out the features of design which make them long-lived and trouble-free. Four pages are devoted to "Types . . . Sizes . . . and Prices" complete with illustrations and line diagrams besides the tabular ordering information. Dimensional tables of the six types of unions are given in the back and a page covers the terms and conditions of sales. E. M. Dart Mfg. Co.

23 **Flexible Pipe Couplings** — Flexible pipe couplings which permit 40 deg. flexibility at each coupling and which are said to save up to 500 per cent in pipe coupling time are described in a new booklet. The catalog shows how the units are easily assembled without the use of tools other than a hammer. Photographs show installed couplings and the coupling itself is pictured in detail. Table of specifications and line drawings are given. Drinkwater, Inc.

DIESELS

24 **Water Wheels, Diesels, Power Units**—Describing Pelton water wheels, diesels, power units and many other company products, the latest edition of "Baldwin" is highly useful and informative. The

Coupon must be filled in completely to secure literature you request. Pasting coupon on penny postcard saves time and money.

MAY, 1946

POWER PLANT ENGINEERING

53 W. Jackson Blvd.
Chicago 4, Illinois

Please have the manufacturers send me without obligation the literature indicated by the following paragraph number.

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Your Company Name .....

Company Address .....

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(If you prefer delivery at your home also fill in below)

Home Address .....

City ..... State .....

book is well illustrated and brings to light many amazing facts regarding the manufacturer's production and products. Baldwin Locomotive Works.

25 **Diesel Engine**—Featured by a huge cross-sectional wash drawing, a new brochure issued by this company tells all about a recently designed diesel engine which was made primarily for locomotive use. All major parts of the engine are labeled on the cross-sectional drawing. The Cooper-Bessemer Corporation.

WELDING, BRAZING

26 **Handbook on Brazing and Welding**—"Welding and Brazing of Copper and Copper Alloys," is the title of a 32-page handbook of procedures and materials just issued. There are three principal divisions in this comprehensive treatise. In the introductory section definitions of processes and materials are presented, accompanied by a table of compositions and alloys. Welding characteristics, suggestions for preparing parts for welding, design of joints and use of jigs and fixtures also make up this section. In the second section each of the common copper alloys is discussed with reference to working and other characteristics. The third section is devoted to welding and brazing materials for copper and copper alloys and the general plan of treating each material separately is followed. C. E. Phillips & Co.

27 **Electrode Choosing Wall Chart** — Titled the "Selectrode" chart this new wall chart tells which electrode to use, when to use it and how to identify it. The pages are made of Bristol board and may be turned to the various sections which are indicated by tabbed edges. The sections are labeled: "Mild Steel Electrodes," "Low Alloy Steel Electrodes," "Stainless Steel Electrodes," "Non-Ferrous and Cast Iron Electrodes," "Surfacing Electrodes," and "Gas Welding Rods." The chart also suggests applications, shows currents, positions and physical properties. National Cylinder Gas Company.

28 **Welding Data**—Information on low temperature welding rods and fluxes is included in the latest publication by this manufacturer. Complete listings of the types of rods and fluxes to use for various jobs is one of the most useful features of the bulletin. Ordering information is also presented. Eutectic Welding Alloys Corporation.

POWER TRANSMISSION

29 **V-Belt Drive Guide Book**—An exceedingly well arranged and highly useful guide to assist in figuring V-belt drives has just been announced. It contains twelve pages, nearly every one of which is packed with informative tables and charts. Service factors for various applications—from bakery machinery to pumps and paper machinery—are given; a handy belt selector chart, information on sheaves; an illustrated index to the complete line; table of list prices and stock sizes of the belts; a sheave selector chart for various horsepower ratings; tables of sheave dimensions; bushing classification tables are but a few of the features to be found. Allis-Chalmers Mfg. Co.

30 **Flexible Couplings** — This 24-page, well illustrated booklet is devoted entirely to this company's line of flexible couplings. Included are: the inside story of the coupling; why the Ajax principle provides the right hook-up for power; the distinctive parts of the coupling; horsepower ratings; service factors; dimensioned drawings and tables of sizes and specifications for each type of coupling; and a section devoted to special couplings. Examples of the various types of installations are shown. Ajax Flexible Coupling Co.

31 **V-Belt Folder** — A small folder on "Veelos—The Adjustable V-Belt," has just been issued. Three illustrations show steps in the installation of the belt. Twelve important advantages of the V-belt are described and 11 features of the link construction are listed. Manheim Manufacturing & Belting Company.

32 **Data Book On Automatic Clutches**—These clutches, which are said to be available in sizes from fractional horsepower up to 5000 hp for any type of power drive, are described in this 8-page booklet. A full page is devoted to "Clutch Operation," two others to line drawings of types of clutches and typical applications. Hardinge Co., Inc.

TRAPS

33 **Trap Data Bulletin**—Float and Thermostatic traps are dealt with in this latest bulletin. Carefully compiled and well illustrated the booklet is easy to refer to. Cross sectional drawings, exploded views, dimensioned drawings and tables of capacities add to the usefulness of the data presented. Illinois Engineering Co.

34 **Steam Traps and Strainers**—Steam traps, radiator traps and strainers are covered in booklet issued by this company. Cutaway views of the units are shown in each instance and features are listed. Tables of specifications for ease in ordering are included. Details of operation of steam and radiator traps are given. Cryer Trap & Valve Co., Inc.

PUMPS, COMPRESSORS

35 **Data Book On Pumps**—This 14-page booklet tells all about this pump which is said to pump either light or heavy viscous liquids, to transfer, meter or proportion, to maintain volumetric efficiency, to automatically compensate for wear, etc. Details of twelve listed features such as those mentioned above are described in the booklet and important construction details are shown. Engineering data, motor horsepower requirements, prices and illustrations make the booklet more useful. Marco Co., Inc.

36 **Air Compressor Bulletin**—There are eight pages in this bulletin devoted to the WG-9 Industrial Air Compressor. The unit is pictured in an actual installation and a "take-apart" view shows all the parts and presents a brief description of the features of each part. The center spread of the bulletin gives 25 reasons for the unit's dependability. Other features of interest comprise the remainder of the booklet. Sullivan Machinery Company.

37 **Pumps for Many Services**—This new folder describes Varifio power pumps and points out their distinctive simplicity and their advantages. A four-color illustration shows the pumping mechanism and the control mechanism and calls attention to the totally enclosed features of these units. Sizes and ratings are listed tabularly. One section tells how the pumps operate. Worthington Pump & Machinery Corp.

38 **Spotting Air Where Needed**—Bulletin C-5 describes Fuller rotary air compressors; shows how these compressors, "spotted where you need the air," eliminate the cost of long pipe lines, insure savings in power and maintenance. Fuller Co.

39 **Centrifugal Pump Shaft Seal**—"The Answer To Your Stuffing Box Problems" is the title of a new bulletin. The booklet is a graphic description of the uses and features of the Cameron Shaft-Seal, described as the culmination of 17 years of constant study of the problem of preventing leakage along the drive shaft of centrifugal pumps. The booklet is full of cross sections, exploded views and pictures of typical installations. Performance records are given for a number of liquids. Ingersoll-Rand Co.

40 **Proportioning, Transferring, Metering**—Describing this company's line of transferring, metering and proportioning pumps and homogenizers is the function of a recently issued catalog. Phantom views and dimensioned views of the products are given and the reasons why they perform as they do are listed. The book is well illustrated. Marco Company, Inc.

41 **Midget Pumps** — This vest-pocket handbook type of literature describes and illustrates this manufacturer's midget pumps and laboratory stirrers. The forepart of the booklet tells about the "family" of pumps and lists and describes features common to each of the units. Following this section the book takes up each model in detail listing construction, priming and control, alloys, specifications, performance. Eastern Engineering Co.

INSTRUMENTS, CONTROLS

42 **Slide Rule for Heat Loss Calculations**—A slide rule type of calculator of particular interest to boiler room operators is being offered by this organization. The calculator is used after the per cent of CO_2 in the flue gas, the temperature of the flue gas and the room temperature have been determined. The calculator is based on several fuels of different analyses and a wide range of flue gas temperatures making it practical for use in the vast majority of boiler rooms. The figures on the calculator reveal the per cent of total heat loss in the flue gas. Instructions accompanying the slide rule show how heat loss can be converted into terms of fuel loss. The calculator is made of a heavy, clear plastic material. Hays Corp.

43 **Instruments Data Book**—The complete line of this company's electrical instruments is described and illustrated in this 12-page booklet. Dealt with are insulation testing instruments, vibrating reed frequency meters, tachometers, ohmeters, water testers, capacitance meters, rheostats and many others. The company's repair service is outlined briefly. James G. Biddle Co.

44 **Controlling Water Level**—Controlling the water level on 675 psi boilers in an Eastern utility plant is the subject of a four page performance report issued by this company. The bulletin shows a cross-sectional drawing of the boiler and a full-page photo of the relay-operated Copes Flowmatic regulator which is installed in the plant. The back page presents charts of water level, water flow and steam flow and presents a brief description of the installation. Northern Equipment Co.

45 **CO_2 Indicator Circular**—This new circular describes the company's new small portable instrument (Stack-O-Meter) for indicating CO_2, stack temperature and draft reading. The bulletin gives specifications and describes the various features of the unit. Davis Emergency Equipment Co., Inc.

46 **Pneumatic Transmitters**—A new data book—No. 1000—has just been issued by this company. Containing 28 pages, the booklet contains complete information on pneumatic transmitters which are described as operating on the force-balance principle. They are used for the control of flow, pressure, liquid level, liquid density and differential vapor pressure. Republic Flow Meters Corp.

47 **Meter Action Data**—A new bulletin describes in detail the features of this manufacturer's bellows type differential meter body which requires no mercury. A cross section drawing of the meter body clearly illustrates the unique method used to transmit bellows action to the pen arm. The meter body shaft is completely isolated from the measured fluid. Ranges available, both as recorders and controllers, are listed. The Bristol Company.

48 **Viscosimeter**—A new kind of viscosimeter is described in a recently issued technical bulletin. The operational characteristics are described as representing a radical departure from conventional methods. It is described as useful for continuously blending lube oils and in the maintenance of constant fuel oil viscosity for better burner operation. Fischer & Porter Co.

MAINTENANCE

49 **Maintenance Handbook**—A digest of 71 different maintenance and related jobs in steam generating, electric power or light plants has just been issued. The purpose of the 22-page book is to show how better to perform commonly recurring power plant maintenance and cleaning operations more effectively and at lower cost. It gives specific method and material recommendations for handling cleaning, degreasing, descaling, derusting, paint stripping and related operations. Among these are: cleaning and descaling heat exchange equipment; salvaging of pumps, valves and fittings; stripping paint and varnish from motor housings, radiators, transformers, etc. Oakite Products, Inc.

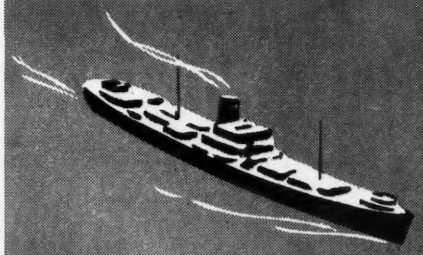
50 **Banding and Splicing**—How to splice electric welding cable, repair split truck handles, avoid replacement of beams, are some of the jobs outlined in this six-page folder. The clamp is shown and described and the various tools which may be used to fasten and tighten the clamp are also described. Tables of sizes, prices and materials are given. Punch-Lok Co.

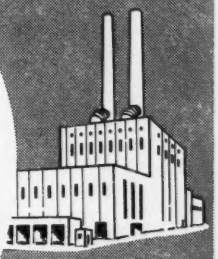
51 **Extracting Broken Pipes**—This four-page bulletin tells about the company's extracting tools for broken pipes and studs. Features, such as: "Grips without hammering or pounding," and "Four point grip prevents extractor from reaming," are listed and then sections headed, "How It Works," and "What It Does," are presented in detail. Methods of use are well illustrated. A photo of the complete set nested in handy tool carrying kit is shown. Reps Tool Co., Inc.

52 **Handbook on Repair Clamps**—This handbook starts off with the unusual approach which shows how much leaks of air, steam and water will cost, in dollars and cents, for various sizes of openings in the line. The chapter headings indicate the type of material included in the book. These are: Emergency Pipe Clamp; Pipe Line Clamp; High Pressure Weld Clamp; Pipe Joint Clamp; Collar Leak Clamp; Vented Plug Clamp; Welding Patch; Non-Shift Service Saddle; Service Saddle; Saddle Tee; Tables on gasketing; valve and bibb reseater. The booklet is well illustrated and tables of sizes, weights, prices, etc. are given. M. B. Skinner Co.

(Continued on page 174)

WIZARD CONDENSER INJECTOR

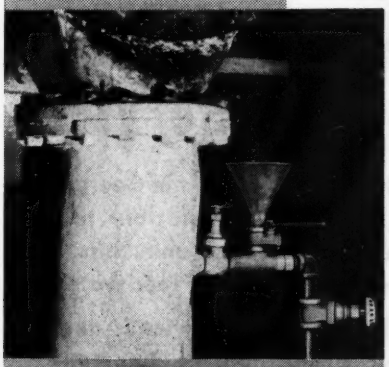




For marine or stationary plants

CONSECO

Positive protection against untimely condenser shutdown



Wizard Condenser Injector, showing simplicity of installation in condenser circulating water line between circulating pump and condenser.

The Wizard Condenser Injector offers a simple, inexpensive positive means of stopping tube leaks instantly while the unit continues to operate. Defective tubes can be plugged or replaced at the next regular servicing.

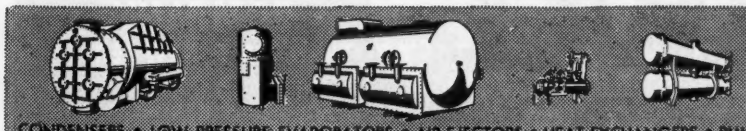
The injector is installed as shown in the picture. When a leak occurs the unit injects an inexpensive, harmless dry sealing compound into the circulating water, and stops the leak instantly. The injector will give a lifetime of trouble-free service.

Your condenser tubes are bound to leak sooner or later — probably at some inopportune time. Even a brand new condenser or one just retubed can start leaking. Get permanent protection at insignificant cost with a Wizard Condenser Injector. Send for new bulletin.

SERVICE *A highly skilled, specially equipped service organization, ready for immediate action anywhere on the continent, backed by engineering and manufacturing facilities producing over 3,000,000 sq. ft. of heat exchangers annually.*

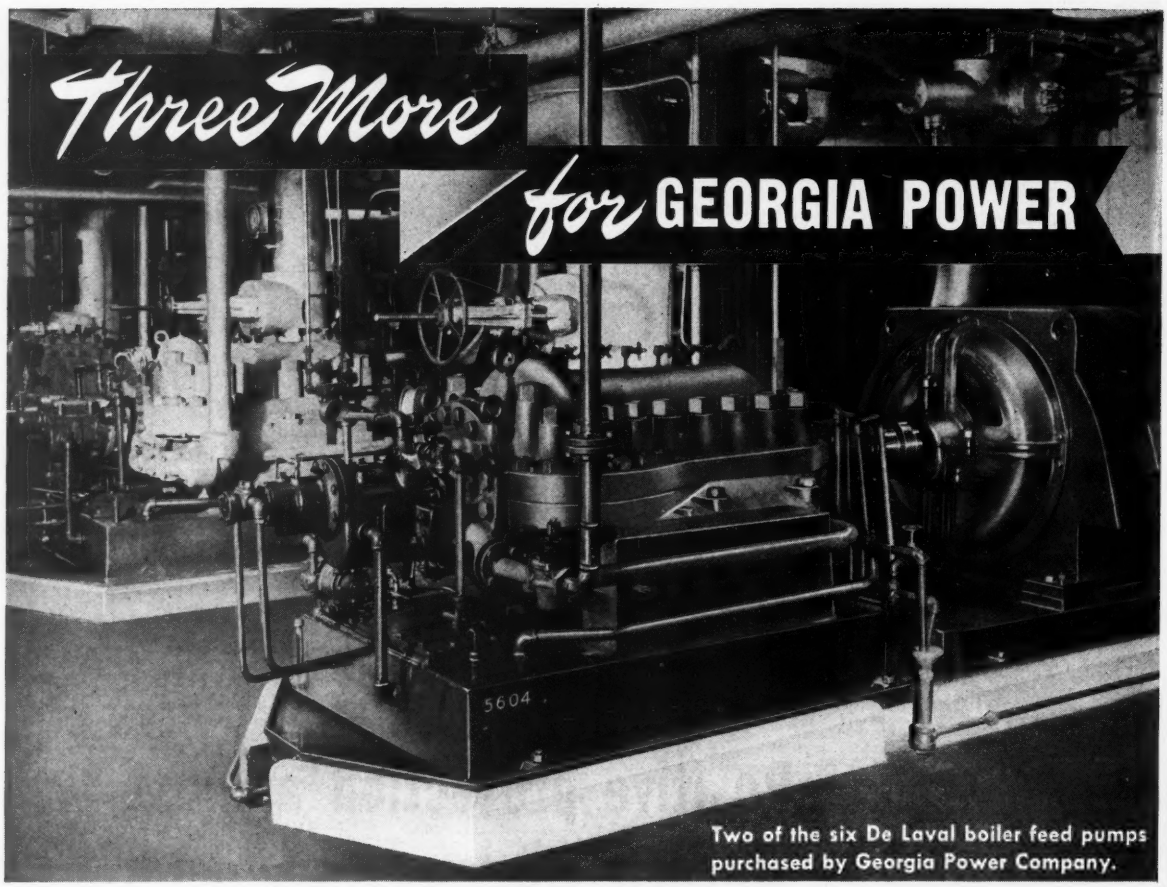
CONDENSER SERVICE & ENGINEERING CO., INC.

71 RIVER ST., HOBOKEN, N. J. Phone HOboken 3-4425 After 6 P.M. or Sundays - HOboken 3-4428



CONDENSERS • LOW PRESSURE EVAPORATORS • AIR EJECTORS • HEAT EXCHANGERS • PUMPS

TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
BEVEL GEAR UNIVERSAL JOINTS
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS



Two of the six De Laval boiler feed pumps purchased by Georgia Power Company.

Reliability of DE LAVAL Boiler Feed Pumps Demonstrated in HIGH PRESSURE Service

Three De Laval high pressure boiler feed pumps were purchased by the Georgia Power Company several years ago. Their performance has proved so satisfactory that subsequently three more De Laval units were ordered. Each of the latest units has a capacity of 1455 gpm. against 1013 psi discharge at 1770 rpm., handling 316° F feed water.

The satisfactory performance of De Laval pumps in high pressure service is due, among other things, to the rigidity of De Laval solid end head construction, the automatic action of the De Laval hydraulic balancing arrangement, and the leak-minimizing effect of De Laval Labyrinth Wearing Rings.

In other installations De Laval boiler feed pumps have proved their dependability handling high temperature feed water at pressures of up to 1600 psi.

BF-1

TURBINES · HELICAL GEARS · WORM GEAR SPEED REDUCERS · CENTRIFUGAL PUMPS · CENTRIFUGAL BLOWERS AND COMPRESSORS · IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY
TRENTON 2, NEW JERSEY

SALES OFFICES ATLANTA · BOSTON · CHARLOTTE · CHICAGO · CLEVELAND · DENVER · DETROIT · DULUTH · EDMONTON · GREAT FALLS · HAVANA · HELENA · HOUSTON · KANSAS CITY · LOS ANGELES · MONTREAL NEW ORLEANS · NEW YORK · PHILADELPHIA · PITTSBURGH · ROCHESTER · ST. PAUL · SALT LAKE CITY · SAN FRANCISCO · SEATTLE · TORONTO · TULSA · VANCOUVER · WASHINGTON D.C. · WINNIPEG

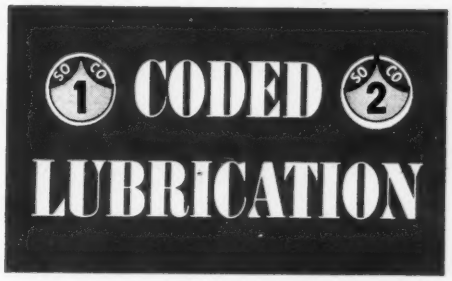
Two services that help you to lower lubrication and maintenance costs

TWO HELPFUL services described at the right are offered by Standard Oil to manufacturers in the Middle West. They are designed to take guess work out of plant lubrication. First, by providing experienced Lubrication Engineers to help you choose the right lubricant for every application. Second, by insuring that the *right* lubricant is applied in the *right* places by means of a coded lubrication system. You can get both of these services by writing Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, and asking for the Lubrication Engineer nearest you.

Lubrication Engineering Service

Standard Oil has experienced Lubrication Engineers located in principal cities throughout the midwestern states shown on the map.

These Engineers have two advantages when analyzing your lubrication needs. They are familiar with the operation of all types of plant equipment — as are your plant personnel — and they have a complete knowledge of the lubricants available to meet your requirements. Thus Standard Oil Lubrication Engineers can help you *get the right lubricant.*



In addition, these Engineers can supply you with a simple Coded System for applying lubricants. Briefly, the system provides for numbering all lubricants used in your plant. Every drum, oil can, or grease gun used for dispensing lubricants is identified by a number to indicate the lubricant it contains. Each spot to be lubricated is also marked by a number to indicate the lubricants required.

Your oilers follow the code numbers. The *right* lubricant is applied to the *right* places every time.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

Fewer oil changes... less deposit with improved

STANOIL

FOR 18 YEARS Standard has provided an oil containing additives to reduce oil oxidation and formation of acidity and deposits in turbines.

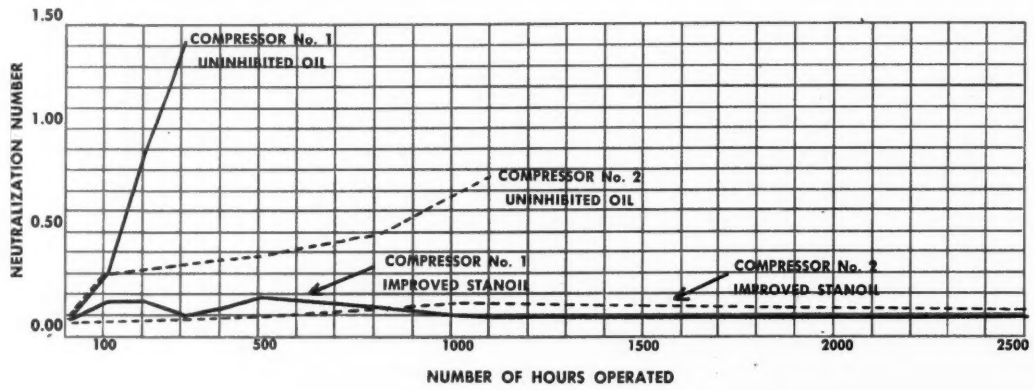
Now Standard has developed and incorporated in Stanoil an additive which improves oxidation resistance for a wide range of industrial applications. Improved Stanoil has been tested under the most severe operating conditions on many types of service: compressors, reduction gears, circulating and hydraulic systems.

Records of one of these severe tests in two compressors are charted below. They show the greatly reduced rate of acidity formation in Improved Stanoil as compared with oils previously used.

Try Improved Stanoil. Compare oil replacement records with the oil you now use in gear cases, circulating and hydraulic systems. Note how Stanoil reduces deposits in compressors.

A Standard Oil Lubrication Engineer will help you make a test. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.

Adverse operating conditions and 24-hour a day operation imposed severe demands on the lubricating oil in two mine compressors. Conventional oil rapidly increased in acidity, as shown by the chart. Improved Stanoil maintained a safe low acidity throughout the 2500 hour test on Compressor No. 1 and for an additional 700 hours on Compressor No. 2 until it was shut down. Make-up was comparable with both oils.

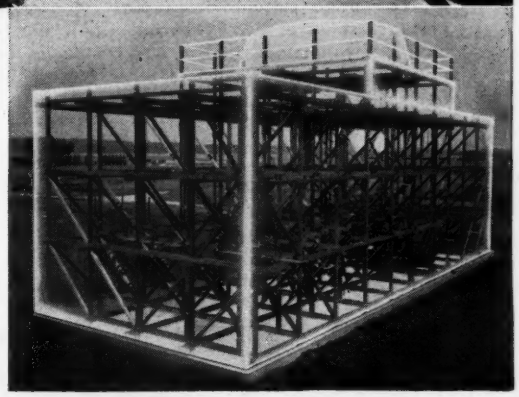


STANDARD OIL COMPANY (INDIANA)

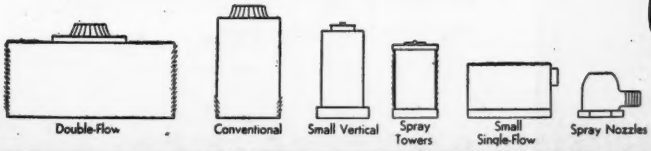
STANDARD SERVICE

Why MARLEY TOWERS Require No Guys

THE *Answer* IS ON THE INSIDE!



where exclusive Marley structural design provides built-in sinews of everlasting redwood that resist 100-mile wind pressures or earth vibrations of great intensity and duration. This rugged stability is achieved without excessive use of materials.



MARLEY COOLING TOWERS

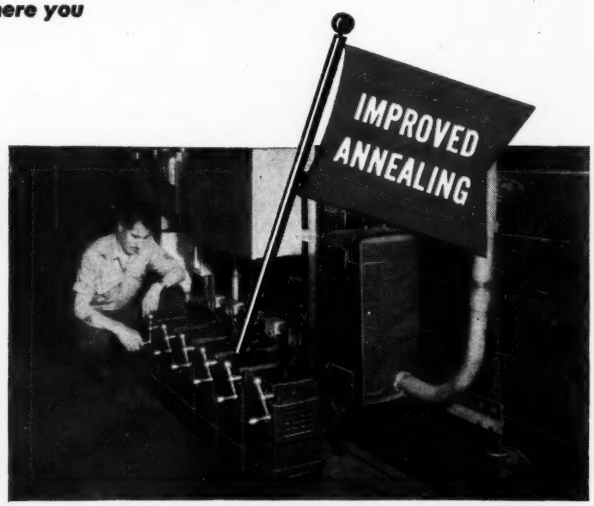
THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

THE RIGHT VOLTAGE AT THE RIGHT PLACE

It's surprising how many places there are around a factory where *close voltage regulation* can improve processes or working conditions. All five regulator installations shown here, for example, are paying their way at one typical plant—probably similar to yours in many of its operations.

In planning more efficient electrical usage, be sure the right voltage is *right where you want it*. General Electric's full line of feeder voltage regulators—large and small—manual and automatic—can meet any problem where volts or kilovolts must "toe the line". And your local G-E office can deliver whatever technical aid you need to apply them to the job. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

1 These dry-type induction voltage regulators are used to control temperature of a wire-annealing operation. Twelve strands are processed simultaneously, each regulator acting to control the current-flow through series-connected sections of two conductors. These hand-operated regulators make it easy to adjust for different conductor sizes and other changes in operating conditions.

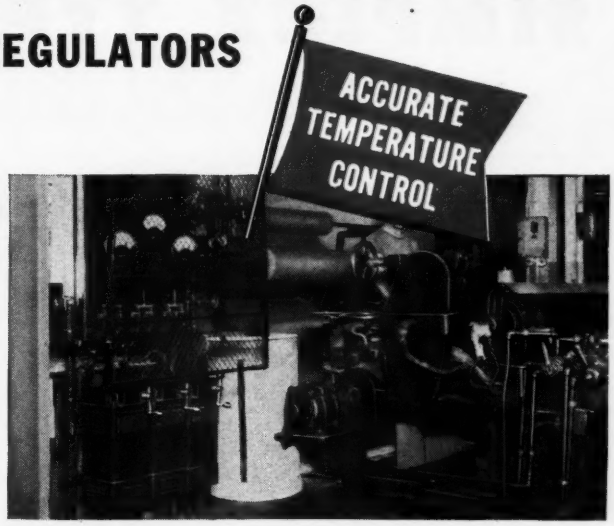


2 Smooth, stepless voltage control for 100,000-volt testing equipment is provided by this 5-kva dry-type induction voltage regulator. Connected in the primary (low-voltage) side of the step-up transformer, this regulator affords 100 per cent raise-and-lower regulation, so that output test voltage can be varied from 0 to 100 kv, simply by turning the crank.

...PAYS OFF 5 WAYS AT A SINGLE PLANT

USING G-E VOLTAGE REGULATORS

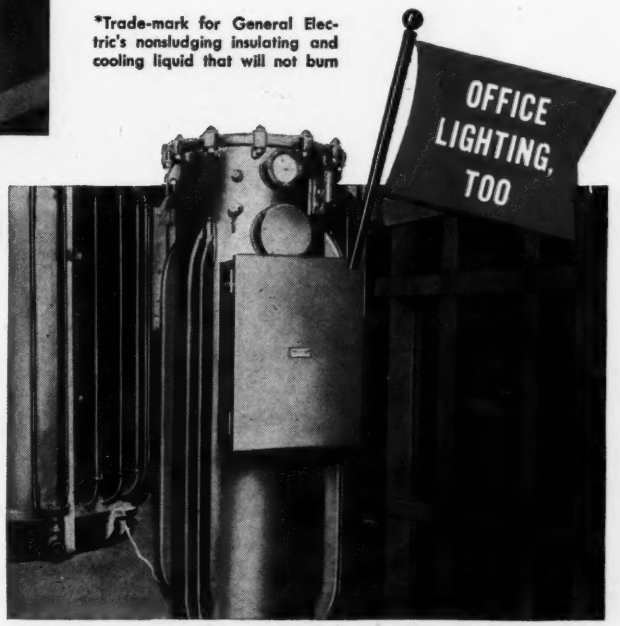
3 Electric heating circuits on a hot-rolling press used to fabricate laminated plastic forms are maintained at the required temperature with induction voltage regulators. Circuits for two electrically heated rollers and one hot plate are separately controlled by the hand-operated regulators, giving close control of processing.



4 Automatic voltage regulation by means of this dry-type induction regulator has "paid off" in a more uniform level of illumination. The full visual value of every kw-hr is obtained with fewer lamp burn-outs from overvoltage. Production space is saved by locating the regulator on a platform along with the Pyranol* transformer which serves the lighting circuits.

*Trade-mark for General Electric's nonsludging insulating and cooling liquid that will not burn

5 This 48-kva Pyranol induction voltage regulator, installed in a basement substation, automatically maintains the proper voltage for lighting circuits in the plant office building. A Pyranol regulator was chosen for its safety in this confined indoor location.



For complete information on any of General Electric's voltage regulation equipment, write for the following publications:

Oil-Immersed Induction Voltage Regulators—Type IRS
GEA-2018 (24 kva and smaller)
GEA-2985 (36 kva and larger)
Pyranol Induction Voltage Regulators—Type IRS, GEA-3443
Dry-type Induction Voltage Regulators—Type AIRS, GEA-3057
Inductrols (Small Dry-type Induction Voltage Regulators) GEP-238
Automatic Voltage Stabilizers GEA-3634
Variable-voltage Autotransformers GEA-3635

GENERAL ELECTRIC

404-38-5400

HERE ARE ALL THE FACTS ABOUT THE

SIMPLEX TYPE MO METER

The High-Accuracy Flow Rate Meter

Write today for your copy of Bulletin 300 which details the operation, use, specifications, and accuracy of the Simplex MO flow rate meter. Specified by operating men and management from coast to coast.

SIMPLEX VALVE & METER COMPANY

6783 UPLAND STREET, PHILADELPHIA 42, PA.

Home Town Enterprise

on a Nation-wide scale

OTIS MAINTENANCE FOR OTIS ELEVATORS

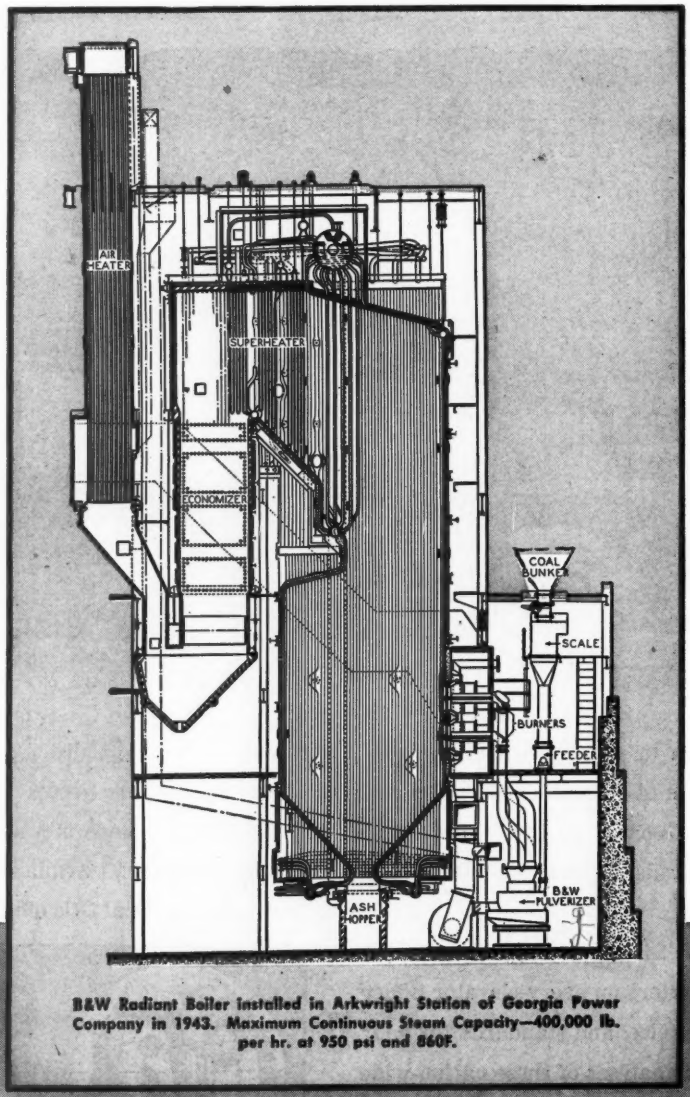
The men and women in your local Otis office — friends and neighbors of your townspeople — are working to maintain service on Otis elevators in your locality — at standards based on nation-wide experience.

Your office and the 244 other Otis offices report regularly to headquarters on every elevator under Otis Maintenance Service, and standards for your locality are based on analyses of these nation-wide reports. If yours is a small freight elevator, it must compare favorably with 5,700 others in its class. If you have a high-speed gearless passenger installation, it is graded against more than 3,000 others in the same group.

Otis Maintenance is a service by Otis for Otis elevator owners . . . available at a flat monthly rate through your local Otis office.

Otis ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES

AFTER 18,000 HOURS



B&W Radiant Boiler installed in Arkwright Station of Georgia Power Company in 1943. Maximum Continuous Steam Capacity—400,000 lb. per hr. at 950 psi and 860F.

INITIAL RUN...

...B&W BOILER TESTS "O.K."

FIRST rest in two straight years—over 80 per cent of the time on pulverized coal! More than 18,000 hours before, this B&W 400,000 lb. per hr. Radiant boiler, equipped with gas and coal burners, had started its record run in the Arkwright station of the Georgia Power Company.

When cooled down for its first inspection, the unit still held the original water, put in weeks before Tarawa and Cassino. Not a single manhole or handhole opening had been uncovered, for any reason, in all that time.

This initial inspection—first in two years revealed:

Boiler in excellent condition: no signs of distress or trouble of any kind.

Superheater: Condition excellent . . .

Economizer: OK . . .

Three B&W Pulverizers: In good shape . . .

Georgia Power Company: More than pleased.

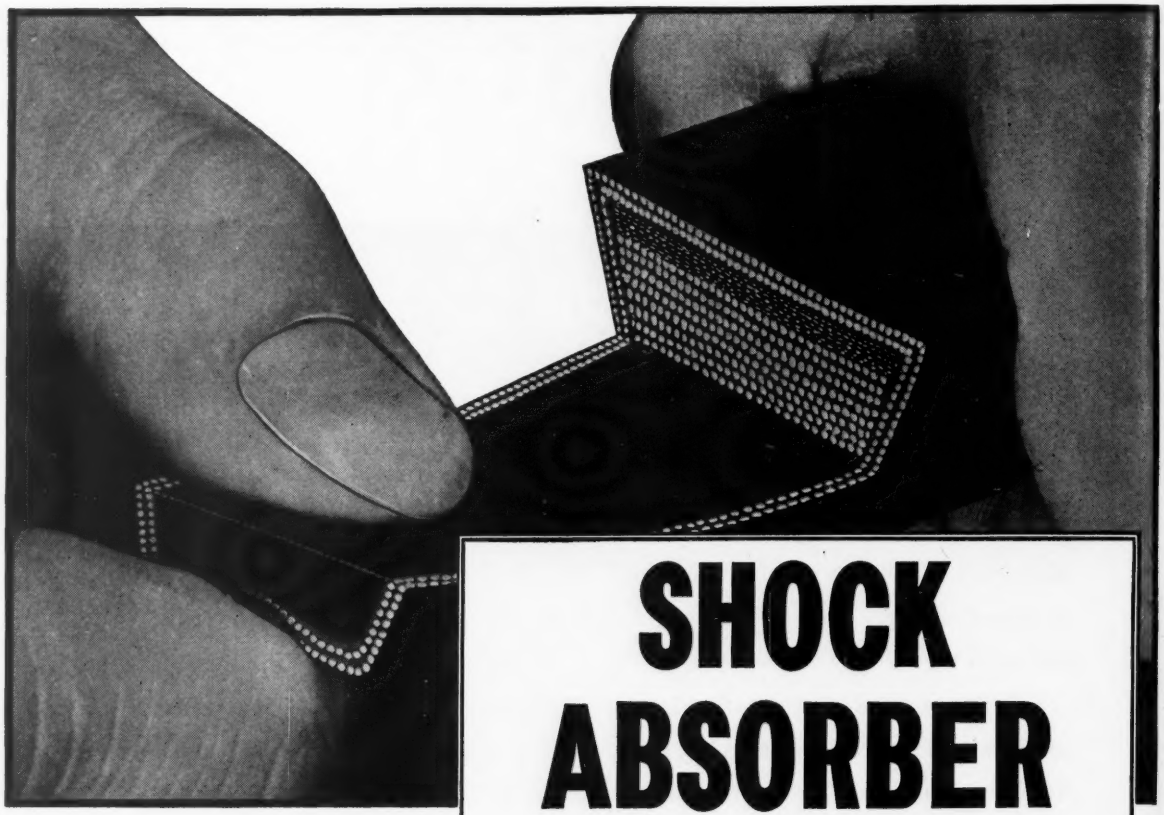
While not trying to set a record, the southern utility, in its 18,000 hr. boiler run, demonstrates once again the dependability and continuity of operation built into every B&W boiler.

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
85 LIBERTY STREET, NEW YORK 6, N.Y.

G-323 T



SHOCK ABSORBER

To Make TEXROPE V-Belts Run Longer

Under the load-pulling cord section of every TEXROPE V-Belt lies a thick, springy cushion of cool-running Buna-S. This cushion acts as a shock absorber to protect the cords from stresses that might weaken them. This carefully proportioned cushion is one of the reasons why TEXROPE "Super-7" V-Belts are known by all industry for their long life and smooth, efficient power transmision. Other reasons are: *More Cords, Stronger Cords,* hard-twisted of selected long staple cotton — *Tough Duplex Cover* to resist wear and keep out dirt — *War-Proved Buna-S* — an improved, cooler-running rubber compound developed for TEXROPE Super-7 V-Belts.

YOUR V-BELT DRIVE HEADQUARTERS

Call your Allis-Chalmers office or dealer for TEXROPE Super-7 V-Belts — for full range of standard, "Magic-grip" and Vari-Pitch sheaves — for Speed Changers and complete V-Belt Drive engineering help. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

HEAR THE BOSTON "POPS": ***Every Saturday Evening, American Broadcasting Co.***

A 2033

5 TEXROPE Super-7 Belts ...Select the one you need

Heat-Resisting Super-7
Stands temperatures up to 180°. The TEXROPE V-Belt for most drives.

Oil-Resisting Super-7
Neoprene cover protects core against moderately oily or greasy conditions.

Oil-Proof Super-7
Made of Neoprene throughout. Use it when the belt must swim in oil.

Static-Resisting Super-7
Recommended where explosion hazard exists. Static-conducting element throughout cover won't wear off.

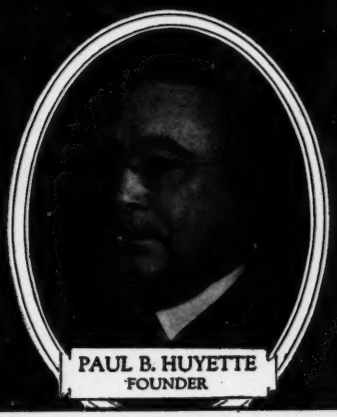
Super-7 Steel
Twin steel cables, to pull extremely heavy loads with minimum stretch.

GET THEM — through your Allis-Chalmers district office or dealer.

TEXROPE Super-7 V-Belts result from the co-operative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

ALLIS CHALMERS TEXROPE V-BELT DRIVES

THE PAUL B. HUYETTE CO., Inc.



PAUL B. HUYETTE
FOUNDER

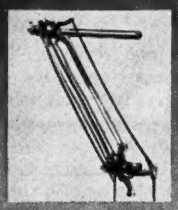
1896 50th ANNIVERSARY 1946

The PAUL B. HUYETTE CO., Inc. celebrates its 50th Anniversary this year, and takes this opportunity to express its appreciation of the patronage it has enjoyed from the Power Plant industry during the half-century just completed. Great changes have taken place in that industry since young Paul B. Huyette founded this business in 1896 . . . and who knows what tremendous changes will take place in the *next* 50 years? But it is our purpose to see that there will be no change in the quality of Huyette products and Huyette service.

S. Louis Huyette
President

MANUFACTURERS OF "P. B. H." BRONZE WATER GAUGE VALVES FOR BOILERS, TANKS AND OTHER VESSELS · ALL IRON GAUGE VALVES FOR CHEMICAL APPLICATIONS · GAUGE COCKS · GAUGE GLASS PROTECTORS · BOILER TUBE CLEANERS · BOILER WALL COATING · STOKING TOOLS · DRIP FUNNELS

and



"P.B.H." TILTVIEW INCLINED BOILER WATER GAUGE

One of the Huyette boiler room specialties that is extremely popular is the P.B.H. Tiltview Boiler Water Gauge, designed for easier visibility where gauges are high above the floor. It is made with screwed or flanged adapters in connection with the regular P.B.H. Water Gauge—a standard in the boiler room for a generation.

401 N. Broad Street
PHILADELPHIA 8, PA.

1896 1946 THE PAUL B. HUYETTE CO. INC. 50th Anniversary

205 E. 42nd Street
NEW YORK 17, N. Y.

in peacetime as in wartime...

During the war a great many VU Units were purchased by plants all over the country in the course of industry's "all-out" effort to produce everything from atom bombs to anchors. "But didn't all equipment manufacturers sell plenty of equipment then?", you say. True enough. It was an emergency. No time for careful analysis — little opportunity to evaluate details of design or factors involving economy and dependability. "How soon can we get it?" was the No. 1 question.

But since the war ended, industry has been looking at things differently. Although in many instances its needs are urgent, its program is now long range. Once again details of design and construction are weighed carefully. Once again a service-proved reputation for economy and dependability is of first importance.

Of special significance then is the fact that over a period of eight months following V-J Day, VU Units with an aggregate capacity of more than 8,800,000 lb of steam per hr have been ordered — more capacity than in any comparable period during the war years when the demand for steam generating equipment reached an "all-time" high. These units have been purchased by leading companies in many branches of industry and in the utility field — companies whose engineering judgment is of the highest order.

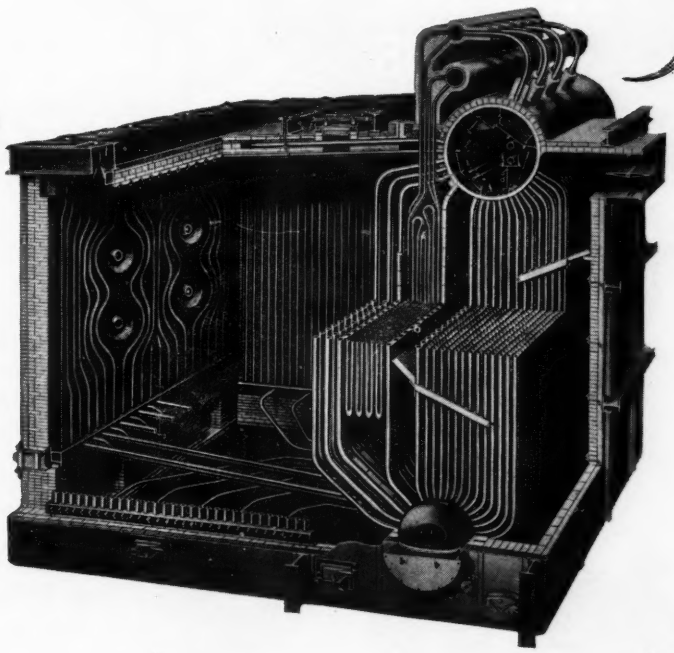
This widespread confidence in VU performance is a reflection of the many advantages listed on the opposite page. Evaluate them point for point. Then you will understand why the VU Unit is so widely regarded as the best steam generator of its type. A-968

APPLICATION RANGE — Type VU installations cover a range of capacities from 30,000 to 300,000 lbs of steam per hr, with pressures up to 1000 psi and total steam temperatures up to 900F; adaptable to firing by pulverized coal, oil, gas or any type of stoker.

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

it's the VU unit



Consider these 6 Advantages:

1. **Symmetrical Design.** Any longitudinal section through the VU Unit is the same as any other. Each has the same amount of furnace volume, the same evaporative surface, the same superheating surface. Each functions under similarly uniform conditions — same mass flow of gases at practically the same temperatures at any given point. Thus each carries the same amount of water and produces the same amount of steam.

2. **Steam Quality.** All of the most active steam producing tubes enter a baffled area in the drum — see illustration — which discharges well above the waterline and uniformly across the full length of the drum. This arrangement reduces turbulence to a minimum and permits effective utilization of the entire steam release space. Dry steam and a stabilized water level are thus assured even under adverse conditions.

3. **Standardized Construction.** Painstaking refinement of detail is incorporated in each unit at a fraction of the original engineering cost. With standard parts and structural features, the merits of which are confirmed by experience, manufacturing and erection costs are materially reduced. First cost reflects the economy of standardized design and the buyer gains this benefit even before the VU Unit is placed in operation.

4. **Overhead Suspension.** Complete freedom of expansion in all directions is assured because all parts of the unit are suspended from the steel structure which provides the framework for the steel casing. This feature makes ample provision for the effects of temperature changes; it eliminates abnormal mechanical stresses on all pressure parts and explains to a large degree the freedom of the VU Unit from leaky joints.

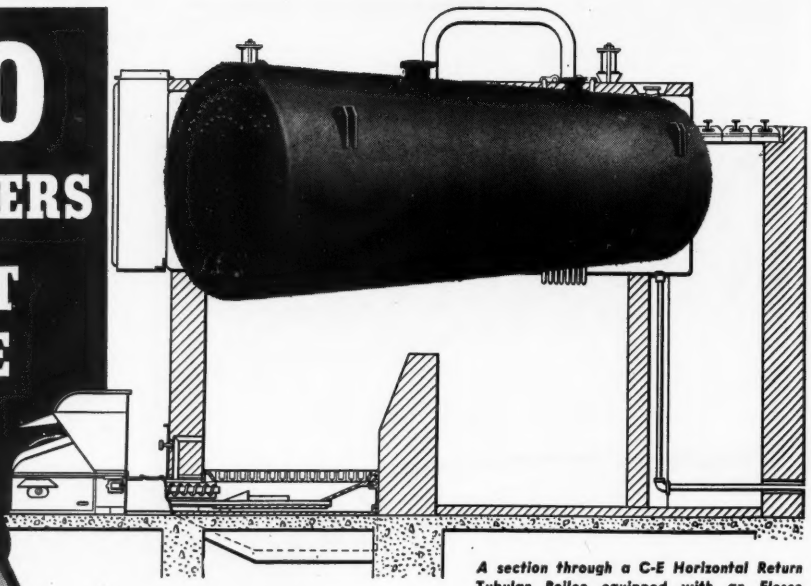
5. **Adaptable in Application.** The VU Unit may be fired by pulverized coal, oil, gas or any combination of these fuels. It is likewise readily adaptable to firing by any type of stoker. These units are suitable for widely varying requirements of load, pressure and temperature. Inclusion of an interbank or intertube superheater, an air heater or economizer, is easily accomplished as conditions require.

6. **Steel Encased Setting.** The unit setting of shaped tile, refractory and 100% insulation are attractively finished by a permanent outer steel casing. This design, evolved from careful study and experiment, reduces to a minimum heat losses caused by radiation and air infiltration. It tends to eliminate hot spots and helps maintain a uniformly low surface temperature throughout the steel casing. Maintenance is negligible.

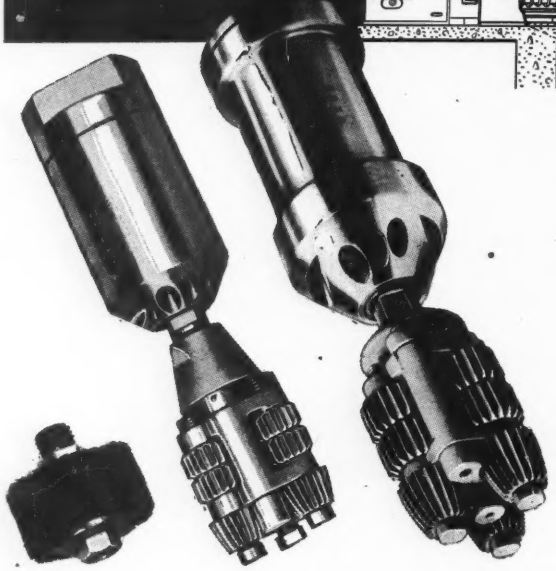
E N G I N E E R I N G

200 MADISON AVENUE, NEW YORK 16, N. Y.

ROTO
TUBE CLEANERS
for C-E HRT FIRE TUBE BOILERS



A section through a C-E Horizontal Return Tubular Boiler equipped with an Elesco Girth Type Superheater and fired by a C-E Skelly Stoker Unit. A photograph of a fusion-welded shell is superimposed on the drawing.



Roto Solid Wire Brush available for tubes from 2½" to 4" ID.

Roto Model 130 Air-driven Motor with swing-frame head.

Roto Model 135 Air-driven Motor with swing-frame head.

C-E Horizontal Return Tubular Boilers are equipped with three sizes of tubes: 3", 3½", and 4". Roto equipment required for cleaning the inside and outside surfaces of these tubes is specified and illustrated. Cleaners and parts for practically all sizes and shapes of tubes can be shipped from stock at once.

ROTO TUBE CLEANER SPECIFICATIONS

For 3½" and 4" tubes—

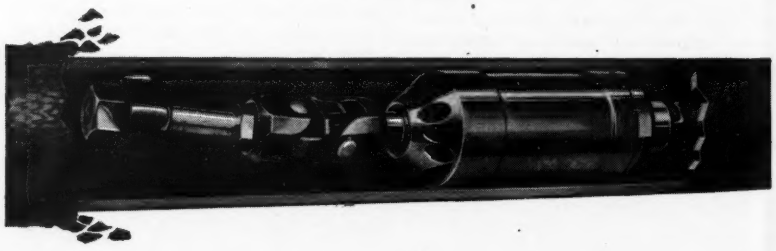
Roto Model 135 Air-driven Motor with swing frame head for hard accumulations inside the tubes. For removing soot or for polishing the tubes, a wire brush with universal joint is used.

For 3" tubes—

Roto Model 130 Air-driven Motor with swing frame head removes hard deposits inside these tubes, and a wire brush with universal joint is used for polishing or for removing soot.

Water scale may be removed from the outside of the tubes by attaching a vibrating head and universal joint to the appropriate size motor. See illustration below.

Illustrating how the vibrating head removes water scale from the outside tube surface.

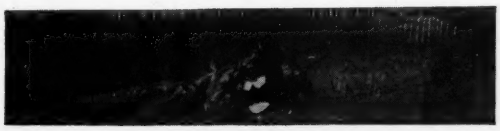


ROTO Division of ELLIOTT COMPANY
147 SUSSEX AVENUE - - - NEWARK 1, N. J.

HOW THE ANODIC POINTS WERE CAPTURED

In many cases where a condenser tube has proven unsatisfactory in a given application, analysis of conditions will show the cause of the failure to be outside the tube itself.

A Scovill engineer was requested to explain the puzzle of the consistent failure of tubes in the first pass of a marine condenser. 18 tubes had failed in this pass, as the result of intense local pitting.

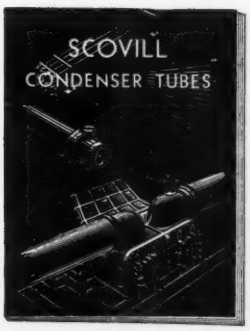


Deposits Had Done It — He found that the pitting was due to "deposit attack", an electrochemical type of corrosion initiated by foreign material lodged against the tube walls. Where such deposits covered the metal, those "islands" became anodic to the adjacent uncovered areas, with resultant intense corrosion of the anodic area. In this case, turbulence of the water passing around the deposit caused erosion-corrosion on downstream side of deposit.

Examination showed no evidence of any other type of corrosion.

The suggestion of the Scovill engineer which aided in the solution of the problem was to modify the circulating water inlet and to establish a regular practice of cleaning the tubes, using rubber plugs, bristle brushes or other equipment that would not score the tube walls.

Three Scovill Services — Scovill *Service in Men* provides specialized study and advice on individual tube application problems and on installation practices. *Service in Metals* includes production of many tube alloys, and also offers you the facilities of our laboratory to help determine the alloy best suited to your conditions. *Service in Manuals* provides valuable literature on condenser and heat exchanger tubes; for a free copy of our Condenser Tube Booklet, address Scovill Manufacturing Company, 17 Mill St., Waterbury 91, Conn.



ONE PRODUCT
THREE SERVICES
Service in Manuals
Service in Metals
Service in Men

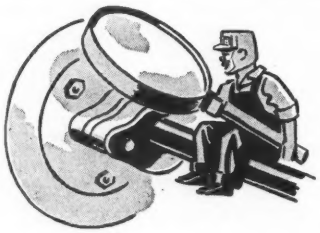
SCOVILL

Scovill
CONDENSER TUBES

The Stuffing Box

TIPS ON GOOD PACKING PRACTICE

NO. 1 OF A SERIES

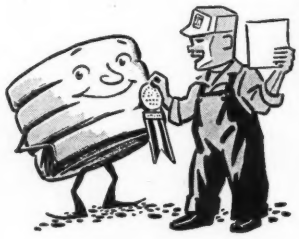


One common-sense way to get the best service out of packing and at the same time save wear and tear on equipment is to have the stuffing box inspected frequently. How often this should be done depends on the type and severity of the service. For example, one packing user we know makes a checkup on every shift because his pumps handle highly corrosive fluids and he can't afford to have anything go wrong. It's the old story of "a stitch in time . . ."

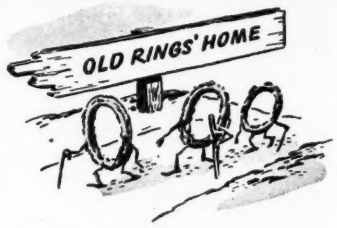
A stuffing box inspection should include these points:

1. Check glands and seals for excessive leakage, adjusting where necessary.
2. Make sure that pistons, rods and plungers run true.
3. See that the gland is pulled up squarely and is not cocked.

Note that we said "*excessive* leakage" under point 1, above. It is good practice to allow a slight leakage where permissible. In the case of newly installed packing, this will allow for expansion and proper seating. It should be remembered that too much gland pressure will cause excessive friction. This not only wastes power, but also increases wear on the moving parts and reduces the life of the packing.



Keeping a "service record" showing the date on which each set of packing was installed and replaced will establish the economic life of the packing. Consult this frequently to make sure the packing is not being used beyond this period. Even though a packing continues to give service it is better practice to replace it, rather than run the risk of damage by waiting until it is completely worn out.



When the gland is "all the way up," it normally indicates that the life of the packing is finished and repacking is necessary. And remember that when you renew packing, it is poor economy to replace just one or two rings. This is like adding a quart of new motor oil to the four quarts of old, worn-out oil in your car. You wind up with five quarts of worn-out oil. Replacing all the old packing is the only way to get a first-class repacking job.

And when you need a packing—there are 400 conveniently located Johns-Manville Distributors ready to supply you with the right one for your job.

A tip on a good packing . . .

JOHNS-MANVILLE SEA RINGS

Unlike ordinary rod and plunger packings, Sea Rings do not depend on gland pressure for proper functioning. They adjust themselves *automatically*—seal on the work stroke, release on the returns thus reducing friction and wear on both packing and rod. To cut *your* maintenance costs, use Sea Rings on your next job. Write Johns-Manville, Box 290, New York 16, New York.

WET COAL CAN'T CLOG THIS Æ STOKER

NEW FEATURES UNVEILED AT 17th BIRTHDAY PARTY

Streamlined dress, simplified operation, improved coal distribution, positive non-clog feed—these are the products of growth proudly presented on the Perfect Spread Stoker's 17th anniversary—a hard-earned tribute to long, economy-proved service in 15 types of industries.

AND THIS is no idle claim. Not *one* complaint of clogging by wet coal has ever been received from our many users.

The Æ Perfect Spread Stoker will feed and burn coal wet or dry, fine or coarse without clogging. It is the only spreader stoker with a travelling conveyor feeder and safety feature that *guarantees* non-clogging *regardless of the size or condition of coal used!*

Every plant has wet coal at some time. End *your* wet coal troubles. Decide today in favor of lower steam costs and cleaner, more efficient boiler room operation with the Æ Perfect Spread Stoker. Write at once for the Æ Perfect Spread Stoker bulletin.

Æ

PERFECT SPREAD STOKER

WITH STATIONARY GRATES, DUMPING GRATES OR CONTINUOUS ASH DISCHARGE —UP TO 400,000 LBS. OF STEAM PER HR.

Other Æ Products: Æ-Taylor Stokers, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power

AMERICAN ENGINEERING COMPANY

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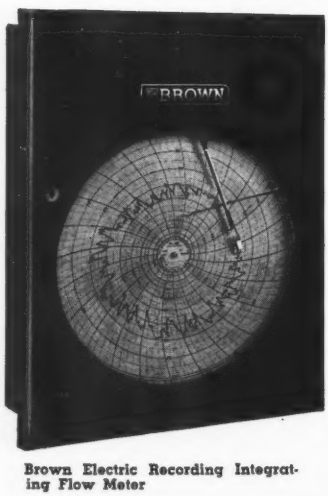
Invaluable To Cost Accounting



Brown Electric Recording Integrating Flow Meter

In the operation of steam boilers—fuel and water are the raw materials which are converted into the useful product *Steam*.

In practically all cases, the cost of fuel represents the major expenditure therefore its conservation is the primary object of maximum boiler room efficiency.

To operate a steam plant efficiently and properly allocate costs, certain quantities must be measured so that an intelligent analysis of performance can be made.

The importance of Brown's Chart Records cannot be over emphasized. They show how much steam is produced and used per fuel dollar expenditure.

The keeping of permanent chart records of temperatures, pressures, flows, liquid levels, etc., is not only considered good management but it is also a modern practice to centralize the measurement of these variables on a main control board. The instruments reveal to the engineer or management any deviation above or below the most efficient operating conditions.

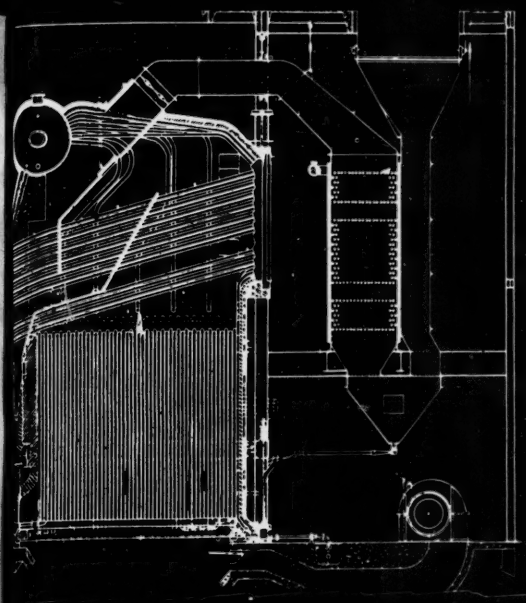
Brown Indicating and Recording Instruments are furnished in standard universal cases, adaptable for any style of panel mounting, they present a uniform and well-balanced appearance.

For information, write THE BROWN INSTRUMENT COMPANY, a division of Minneapolis-Honeywell Regulator Company, 4491 Wayne Ave., Philadelphia 44, Pa. Offices in all principal cities. Toronto, Canada—London, England—Stockholm, Sweden—Amsterdam, Holland.

BROWN INSTRUMENTS

AND MINNEAPOLIS HONEYWELL CONTROL SYSTEMS

For Temperatures . . . . . Pressures . . . . . Flows . . . . . Liquid Levels



• SPRINGFIELD DESIGNS vary in size . . . shape . . . and details, depending on individual requirements. The unit shown in exposed section here is a typical design used with spreader stoker firing. Variations in this design are used with other types of stokers . . . pulverized coal . . . oil . . . or gas firing.

BUILDING BOILERS THAT HELP BOOST PRODUCTION

A Single Aim--

• Springfield Boiler Company is devoting its attention exclusively to the production of modern, high efficiency boilers and their associated parts. This singleness of purpose and specialization is your assurance that your job will get attention second to none when placed in Springfield's hands. Springfield engineering and shop facilities are available for producing boilers to exactly meet your special requirements. At the same time, worthwhile opportunities exist to take advantage of a duplicate of one of Springfield's numerous, modern installations for lower engineering costs . . . quicker delivery . . . proven performance. IT WILL PAY YOU TO CHECK WITH SPRINGFIELD. Write SPRINGFIELD BOILER CO., 1951 E. Capitol Ave., Springfield, Ill.

QUICK FACTS

- **LESS OUTAGE TIME. HIGHER AVERAGE AVAILABILITY.** No need to wait for settings to cool to inspect tubes. No climbing into drums. Quick access to tubes.
- **PLENTY OF OVERLOAD CAPACITY.** Users push rugged Springfield units to high ratings without danger . . . without material loss of efficiency . . . without setting up carry-over difficulties.
- **QUICK RESPONSE TO LOAD INCREASES.** Thanks to small tubes, staggered tube arrangement, across-tube baffling.
- **FREEDOM FROM OPERATING DIFFICULTIES.** Electric cast steel headers — no pitting, corrosion, caustic embrittlement. Welded, x-rayed, stress-relieved drums. Water-cooled furnaces, water-cooled baffles.

SPRINGFIELD

STEAM GENERATING UNITS
ANY SIZE — ANY FUEL — ANY PRESSURE

SPRINGFIELD BOILERS

35.8% SAVING IN

With Iron Fireman Pneumatic Spreader

FOREST PRODUCTS TREATING COMPANY
PRODUCERS & PRESERVERS
OF
POSTS · POLES · PILING
LUMBER · TIMBERS
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PLANTS
THE DALLES, OREGON
LARAMIE, WYOMING
WALDEN, COLORADO

September 17, 1945

Iron Fireman Manufacturing Co.
4784 S. E. 17th Avenue
Portland, Oregon

Gentlemen:

In April, 1943, we installed two of your Iron Fireman Pneumatic Stokers under our two 186 HP., B&W Water Tube Boilers at our plant in The Dalles, Oregon.

During the 12-month period of hand firing immediately preceding the installation of the stokers, our total coal consumption was 10,709,350 pounds. In the following 12-month period we used only 7,093,220 pounds. When these figures are analyzed with plant output, we find that hand firing required 2.1572 lbs. of coal per cu. ft. of wood treated, while stoker firing required only 1.5205 lbs. - a very definite saving of 29½% in our coal bill.

After operating these stokers for some time, flue gas analyses indicated that we were still not getting full efficiency out of the stokers. Accordingly we installed draft gauges and recording CO_2 Analyzers as an aid in making adjustments on the coal feed, under grate air and damper controls. These adjustments are delicate enough so that we can fire with maximum efficiency and produce a chart recording CO_2 at from 14% to 15%, throughout the period between grate cleanings when load conditions are fairly uniform.

As was expected, our coal consumption during the following 12-month period dropped still further, to 1.4057 lbs. per cu. ft. of wood treated, making the surprising total of 35.8% saving in coal with the Iron Fireman Stokers as compared to hand firing under the same boilers.

Yours very truly,

FOREST PRODUCTS TREATING COMPANY

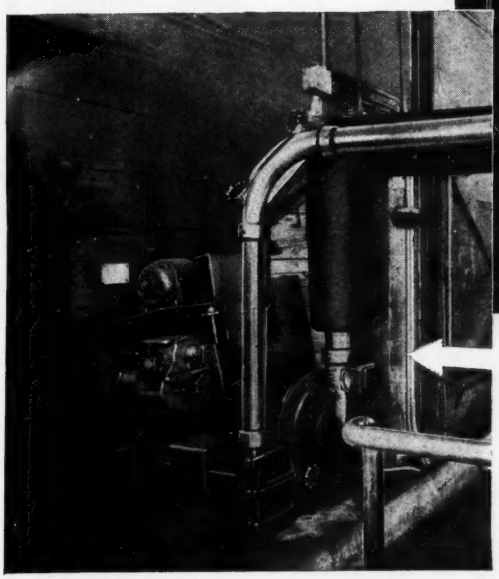
J. I. Hess, Chief Engineer

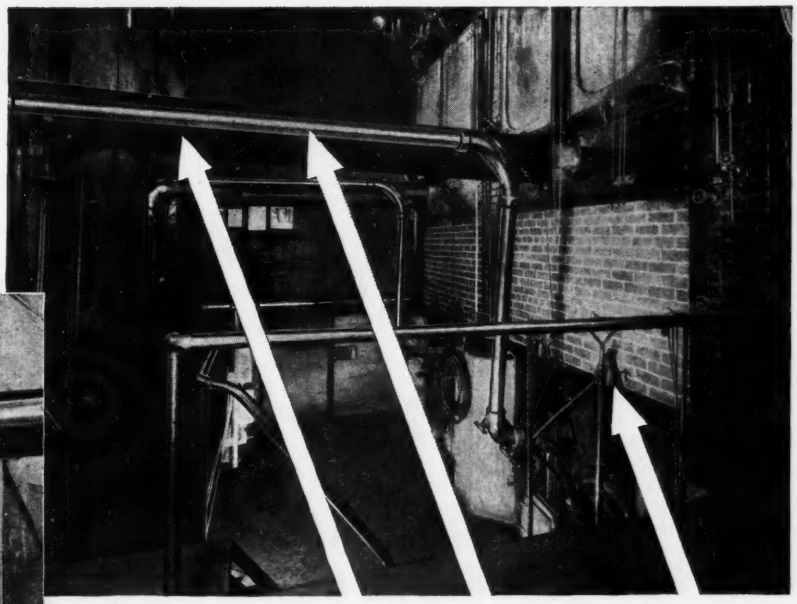
HEAVY DUTY AUTOMATIC COAL STOKER

IRON THE IRON FIREMAN

NCOAL

ler Stoker





COAL PICK-UP SECTION receives coal from bunker through short worm conveyor, where it is picked up by high velocity gases and delivered to furnace.

PRE-HEATED AIR CONVEYOR withdraws hot gases from combustion chamber. Adjustable air intake controls temperature of gases in pneumatic conveying system.

COAL CONVEYOR delivers coal from bunker to furnace, using a mixture of hot furnace gases and air as a conveying medium, preheating fuel enroute.

CLEAR BOILER FRONT Stoker mechanism is not attached to the boiler front but is located near fuel supply, keeping mechanism cool and easily accessible.

Iron Fireman Pneumatic Spreader Stokers installed in Forest Products Treating Company plant at The Dalles, Oregon

Advanced Engineering. The extraordinary record of savings reported by Iron Fireman users is adequate evidence of sound engineering. Highly efficient combustion cuts fuel tonnage. Maintenance costs are remarkably low because no moving stoker parts are subject to high furnace temperatures and all mechanism is easily accessible. Many Iron Fireman stokers have been in continuous service for as long as 20 years.

Adaptability. Because of its simple method of firing and fuel conveying, the Iron Fireman Pneumatic Spreader stoker has almost unlimited adaptability to existing boiler room layouts without costly remodeling.

Flexibility. This stoker has great flexibility of operation because it is highly responsive to widely fluctuating loads, and because it efficiently burns an extensive range of coals, including the small sizes, and low ash fusion coals as well as sub-bituminous and lignite.

Ask for Survey. Iron Fireman's nationwide engineering, sales and service organization has had experience with every size and type of firing job. You can have a survey made of your boiler plant to determine what Iron Fireman stokers can accomplish for you. For such a survey or literature address: Iron Fireman Manufacturing Co., 3050 W. 106th St., Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada.

FIREMAN

FOR POWER PROCESSING AND HEATING

Now Available!

- IN ALL SIZES
- IMMEDIATE DELIVERY

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WHAT LEADERS SAY

The Industrial Plant of the Future

By GEORGE H. MIEHLS

THE WAR has taught us much about the facilities of production. It has taught us new methods of construction; it has taught us to develop substitute materials, and to apply those substitutes in a multitude of ways. But it must be admitted that research during the war years was concentrated on works of destruction rather than construction, and many new materials which we have read about must await further tests of life, adaptability and economy before receiving widespread approval.

Trends not always clearly defined before the war stand out in sharper relief today. Your new industrial plant will be located **outside** the congested urban district permitting ample distribution of facilities, provision of expansion as conditions warrant with adequate personnel facilities. Its location will be selected with a view to proper public transportation as well as adequate highways for private transportation. Given these factors, available manpower in the immediate vicinity, while desirable, is not of primary importance.

You thereby initiate the metropolitan area, because you begin to build a series of communities which transcend the urban boundary. For you, therefore, who are concerned with city planning, your zoning, your planning, your taxation, your slum clearance programs must be predicated on this trend because it is a fact, it's here and it will be accelerated.

Your new industrial plant will stress flexibility in plant layout, and provisions must be made in your design so that this flexibility is inherent.

This flexibility will be obtained by various means and the means will differ with the type of product to be manufactured. A one story continuous line production layout may serve one industry and not another. A structural steel building may serve one industry admirably and with great economy, while a concrete, multistory building may serve the purposes of another much better. It general, I believe that for the large majority of mass produced items, the horizontal conveyance of materials from receiving through manufacturing and assembly to shipping has proved to be the more successful. Industries which have never tried it before are investigating it today.

Much study should be given to the services and utilities which are necessary for production and their location in the building.

Should your industrial plant be of monitor type to provide the maximum of daylight throughout the plant, or should it be of the flat roof type with controlled ventilation and controlled lighting?

Our investigations have shown that in general, except for the psychological advantage that the monitor type building may provide, the trend is toward the artificially lighted, artificially ventilated plant, with sash in the side walls where the worker can see what the weather is out of doors, and which minimizes the atmosphere of confinement.

It is essential therefore that management provide agreeable and convenient employee facilities. The Personnel Department should be so located that applicants for employment may be quickly served. Throughout the plant there should be established easily accessible facilities for First Aid, with access also to each for ambulance transportation for the more serious injuries.

Parking space is an important adjunct to any successfully operated project. Sufficient space must normally be provided for at least two shifts of workers.

The design of the plant itself must make equal provisions for the expeditious handling of employees.

The architectural design of the exterior will be rational, expressing in architectural proportion the romance of industry. Architectural beauty is largely a matter of proportion and requires no artificial ornamentation to enhance it. Properly applied by expert designers, the modern factory can be made a thing of beauty for no greater cost than would be involved in the application of materials in a haphazard, unplanned manner.

In general, I believe that the interior structural frame of your factory will be a skeleton of structural steel or of concrete with columns spaced as widely as possible consistent with cost. It will be insulated with one of the better insulating mediums which you can now obtain or which will be produced in ample quantities in the near future.

In your new industrial plant greater attention than heretofore will be paid to the interior painting. It is being recognized more and more that seeing is not entirely benefitted by more light. Foot candle light level is, of course, important, but seeing is also largely a matter of perception and of visibility. These latter two can be improved by proper selection of color.

The architect and engineer must become a part of his client's plant engineering organization. You must acquaint yourself with his problems—problems of delivery of material, the handling of that material, the methods of manufacture, and the disposal of the finished article. Should he generate power in his boiler house or should he buy it from an established source? Should he use coal or oil or gas for firing his boilers? Should he use stokers or pulverized coal? How should he store his coal to prevent spontaneous combustion in his storage pile? These and hundreds of similar questions are the province of the Architect and Engineer.

George H. Miehls is president of the firm of Albert Kahn Associated Architects and Engineers, Inc. He was chosen for that post by his twenty-five key associates in 1945, following the passing of the last of the founding Kahn brothers. His 26 years of continuous service with the Kahn organization began in 1919 after he had been graduated at Ohio State University in 1917 with the degree of B.S. in civil engineering and had served for nearly two years in World War I, 17 months of it overseas with the 23rd Engineers. During his early years with the Kahn organization, Mr. Miehls filled assignments as structural engineer on such projects as the Hudson, Packard, Ford and Chevrolet plants, newspaper plants and many others. In 1939 his efforts were centered chiefly on the Curtiss-Wright projects, first as structural engineer, then as project manager. In 1943 he was elected vice-president of the Kahn firm, eighteen months later was made executive vice-president and in November 1945 was elevated to his present post as president. The above is from his recent adddress before the Rochester Society of Architects and the Superintendents and Production Managers Group of the Industrial Management Council.

Fundamentals of Electronic

Basic considerations . . . Grid-controlled Rectifying Devices . . . Functions of Grid Circuits . . . Commutation in Electronic Power Converter Circuits . . . Parallel Capacitor Commutation . . . Series Capacitor Commutation . . . Phase Commutation . . . Harmonic Commutation . . . Electronic Frequency Changers in Industry . . . Different Types in Use.

By M. M. MORACK

Power Electronics Division, General Electric Company

Schenectady, N. Y.

THE TERM "ELECTRONIC FREQUENCY CHANGER" is used to designate one member of a family of electronic power converters which is expanding the use of electronic devices in the electric-power industry. The name implies that the means is electronic and that the use is limited to the conversion of alternating-current power of one frequency into alternating-current of another frequency, as distinguished from converters for control or communication purposes.

Much has been written recently in texts[2] and periodicals[1] on electronic power converters for changing alternating-current into direct-current (mercury-arc rectifiers) and the use of grids for controlling the rectifier output voltage. It is also well known[2] that by reversing the d-c connections and providing suitable excitation to the grids, the rectifier may be operated as a power inverter for changing power from direct- to alternating-current. A combination of the rectifier and an inverter represents a simple form of an electronic frequency changer.

To extend theoretical considerations, a few trial installations of the basic types of electronic frequency changers have been in operation for several years. Although much progress has been made, the field of application must evolve slowly while the advantages and limitations are evaluated.

During the war years, approximately 25,000 kw of this equipment has been installed in the electric power field to serve as load regulating non-synchronous ties between large power systems. The renewed activity in railway electrification, and new applications of the grid controlled rectifier in industry, warrant a review of the basic principles applicable to all types of electronic frequency changers.

The Grid Controlled Rectifying Device

Electronic frequency changing equipments consist of transformers, reactors, capacitors, and switchgear conductively connected to rectifying elements. The rectifying devices may take any one of several forms, differing in construction and methods of cathode excitation, but having similar control characteristics to the thyraton. For power converters, the mercury-arc type having an anode, a number of grids, and a mercury pool cathode has proven most satisfactory. The rectifying devices are caused to function as a precise synchronous switch, being closed at a certain point in each cycle by a control grid, and opened by the action of the power circuit.

Figure 1 shows a sectional view of a large penthode-ignitron[3] tube used in high voltage power converters. The cathode excitation is initiated, once each half-cycle, by an ignitor, and the cathode spot is stabilized by use of an auxiliary or holding anode. An intermediate grid serves to divide the potential gradients across the tube during the negative half-cycle of main anode voltage. A control grid determines the "turn-on" point at which anode-cathode conduction will be initiated. Since ionization is present because of the cathode excitation, conduction must first be established to the shield grid, which also functions to clean up residual ions at the end of conduction.

Both grids must be made positive to establish conduction. Assuming that voltage, as shown in Fig. 2 (a), once conduction is established, the control grid exercises no further control over the arc, either to modulate, limit, or extinguish it, and the arc can be interrupted only by removing anode voltage. A grid loses control over its of positive grid voltage for "turn-on" is practically independent of anode and that a positive voltage has been the cathode spot has been initiated, applied to the anode. The magnitude anode while current is flowing and does not regain it until the positive ions and electrons have disappeared from the space surrounding it. This may require hundreds of micro-seconds, during which time the anode must be held negative or the current may reestablish itself. Upon reapplying positive anode voltage the control grid again determines when the arc will start.

In some power converter circuits, this control is made effective by applying an alternating potential between anode and cathode so that the grid regains control each half cycle. The critical grid potential at any point in the positive half cycle of anode voltage where "turn-on" will take place is shown in Fig. 2 (b).

Functions of Grid Circuits

From the foregoing discussion, the first function of the shield and control grids is to act as electrostatic shields allowing anode current to flow when their potentials have been raised to a

The ideas involved in the electronic frequency changer are not new; they have been incorporated in communication circuits for many years. Their development for use in power circuits, however, is something relatively new and it is for this reason that this article is presented here. Power engineers are relatively unfamiliar with the theory and operation of this equipment and Mr. Morak's article should do much to dispel this unfamiliarity. It will acquaint them not only with the basic principles but will also indicate the general type of equipment that is available. Electronic frequency changers of considerable capacity have been installed as will be evident from the example of a 20,000-kw unit described by Mr. Morak installed to transfer power between a 25 cycle and a 60 cycle system in a large steel mill. The development of electronic frequency changers for heavy power duty has had to wait for development of suitable electron tubes but tubes capable of carrying the required power are now available and larger tubes probably will be built in the future.

[1] All references at end of article.

critical value. The grid circuit must furnish a voltage sufficient for rapid ionization with varying temperature and critical grid-voltage characteristics. A second function of the grid circuit is to aid in removing the residual ions after conduction in order that control may be re-established when anode current ceases and the anode voltage again becomes positive. Also, the grids must be maintained negative whenever the tube is not conducting, to prevent small transient voltages from allowing "turn-on" at the wrong time.

Precise control characteristics may be obtained if a-c and d-c voltages are used together. By superimposing a periodic, peaked a-c potential on a negative d-c bias, as in Fig. 3 (a), accurate control necessary for power converters is obtained. This is achieved by making the amplitude of the peaked voltage greater than the magnitude of the negative d-c bias potential, as shown in Fig. 3 (b). It will be seen that the firing angle is unaffected by the variation in critical grid characteristics or by changes in the amplitude of the negative bias or peaked voltage. The firing point may be varied as in Fig. 3 (c) by shifting the phase of the peaked-voltage source.

The operation of the peaked-voltage transformer may be understood by reference to Fig. 4, which shows the relation between the primary voltage, E_p, the primary flux, ϕ_p, the secondary flux, ϕ_s, and the secondary voltage, E_s. Primary flux, ϕ_p, lags the primary voltage by 90 degrees. Secondary flux builds up in the core, giving rise to the secondary voltage, E_s. The high permeability alloy section saturates very quickly when a certain flux density is reached, and the flux, therefore, passes through the magnetic shunt. The flux changes rapidly from the positive saturated condition to the negative saturated condition, thereby producing a peaked voltage of narrow width. During the saturated condition, there is no change in flux in the secondary core. Consequently the secondary voltage is zero.

A typical grid circuit using peaked-waves and a d-c bias is shown in Fig. 5 (a). During the positive half-cycle of peaked-voltage, current flows from the grid to the cathode, establishing ionization first to the shield grid and then to the control grid. At the end of the positive peak, both grids are driven negative by the bias source. The grid then collects ions for the remainder of the main anode conducting period. Since the bias source is maintained by the dry plate rectifier, DPR, the grids assist the anodes in cleaning up residual ionization. Fig. 5 (b) shows the current and voltage wave shapes of the circuit.

Commutation in Electronic Power Converter Circuits

A number of power circuits have been developed which employ rectifying elements for changing continuous current into alternating-current, or the reverse operation of rectification. The control characteristic of the thyratron whereby it can hold the circuit open requires that the function of interrupting the continuous current in the rectifying device, i.e., commutation, must be performed by the circuit.

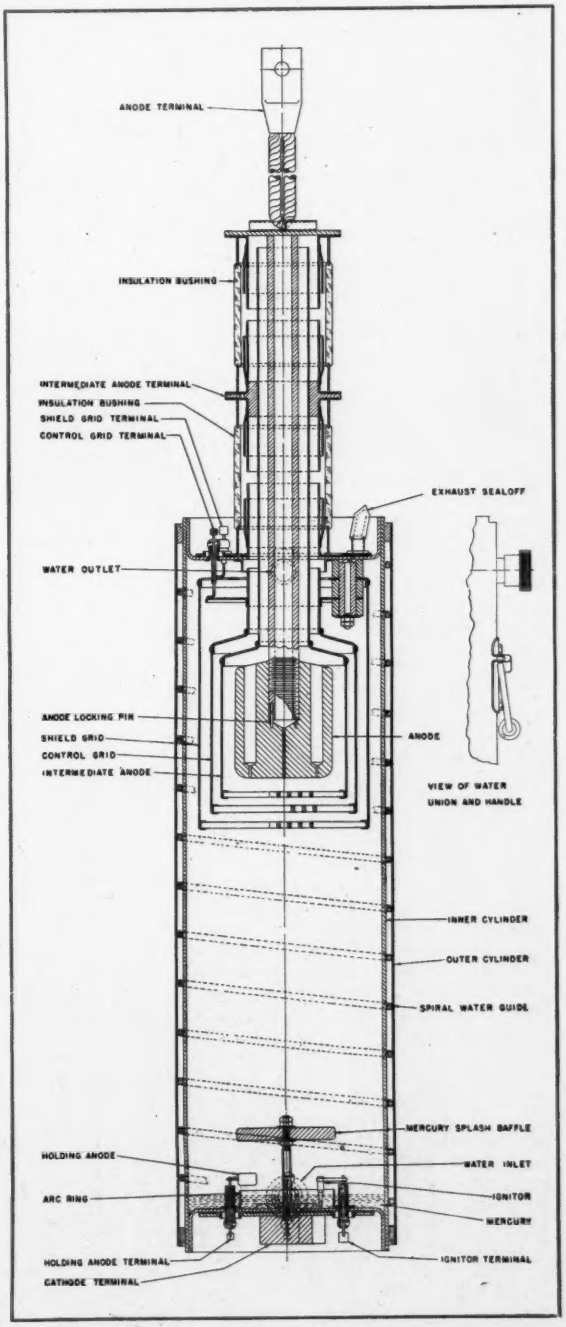


Fig. 1. A pentode-ignitron (vertical section)

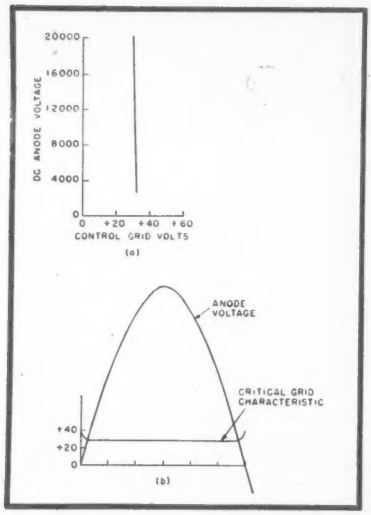


Fig. 2. Critical grid-voltage characteristcis of a pentode ignitron

There are several ways in which circuits may be made to transfer the currents in rectifying elements. The methods of commutation may be classified according to the means employed as:

(a) Parallel capacitor commutation
(b) Series capacitor commutation
(c) Phase commutation
(d) Harmonic commutation

Parallel Capacitor Commutation

In the parallel capacitor commutated inverter,[4] a repeated transient takes place to effect current transfer between two rectifying devices. The power circuit is arranged in accordance with Fig. 6 (a). The direct potential is applied to the neutral of the load transformer T, and the rectifying elements A and B are made alternately conductive by their control elements, the frequency being determined by the pilot exciter. Assuming that the line switch S is closed and rectifying element A is conducting, the capacitor C assumes a potential of approximately twice the applied voltage, with the terminal connected to anode B positive. When anode B is made conducting, the potential of anode A is driven negative relative to cathode, because C cannot discharge instantaneously through the load. The anode of A must be maintained negative for a time sufficient for deionization, otherwise a d-c short circuit takes place. With the new conduction path, the capacitor C charges in the opposite direction, and as it becomes charged, the anode-cathode potential of A increases from a negative value to a positive value as shown in Fig. 6 (b). When A is again made conducting, the capacitor discharges in the reverse direction extinguishing the arc in B. In this manner, rectifying elements A and B alternately conduct current, allowing pulses of current to flow in the primary of the transformer T and the load circuit.

Series Capacitor Commutation

A series capacitor commutated inverter circuit is shown in Fig. 7 (a). The grids of the rectifying elements A and B are oppositely excited by grid transformer G and are normally biased by a negative potential E_B. When the line switch S is closed with the grid of A positive, current flows from the line through A, half of the coupling transformer T, the capacitor C, and the load. During the next half-cycle of grid excitation, the capacitor discharges through the load, the other half of the coupling transformer, and rectifying element B. Thus, the load current is alternating.

It will be noted that any cycle of operation consists of a charge or discharge of a capacitor through resistance and inductance. The current during such action is either a damped oscillation or a damped unidirectional pulse. However, when this action occurs with a rectifying element in the circuit, current can flow only in one direction. An oscillatory current would have to stop when it reached zero after a half-cycle of oscillation.

When the frequency of natural oscillation is greater than the grid excitation frequency, the load current will complete a half-cycle of oscillation and then remain zero until the other rectifying element starts conduction. Then a similar half-cycle of oscillation takes place in the other direction.

On the other hand, in either the oscillatory or unidirectional case, if current has not reached zero in anode A by the next "turn-on" point, the capacitor begins to discharge through B and current is flowing in both rectifying devices at the same tme. Under this condition, current flows directly from the d-c line through both rectifying elements and normal operation ceases.

At this point, an important function of the coupling transformer T comes into play. The rise of current in anode B acts through the mutual inductance of the coupling transformer to induce a voltage in the circuit of A in a direction to oppose the continued flow of current. If the counter voltage is sufficient to bring the current in A to zero, normal operation of the inverter continues.

When the natural frequency of oscillation is the same as the excitation frequency, the inverter produces nearly sinusoidal output current. The current and voltage wave shapes for this condition are shown in Fig. 7 (b).

Phase Commutation

With phase commutation, the transfer of current from one rectifying element to another is effected by the instantaneous difference in potential between the phases involved. The action may be understood by first considering rectifier commutation.

Figure 8 (a) shows a delta, three-phase, wye rectifier where the succession of positive half waves of transformer phase voltage are applied to three anodes A, B and C. The

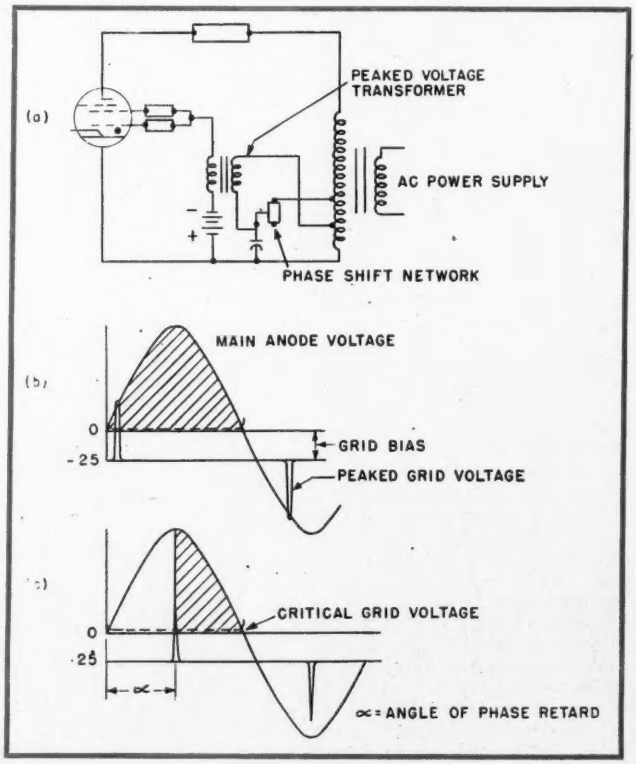


Fig. 3. Elementary grid circuit

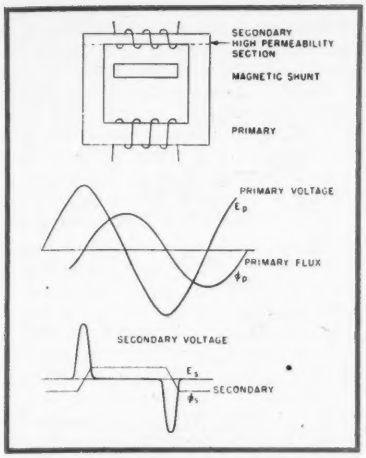


Fig. 4. Transformer for peaked voltage waves

direct-current commutates to the most positive anodes in sequence as shown in Fig. 8 (b). At the instant t_1 of current transfer, anodes A and B are conducting simultaneously and the transformer windings are short circuited. An a-c component I_c flows around the loop in the reverse direction in the outgoing anode A, but is subjected to the condition that it cannot acquire a value greater than the forward current because of rectifier action. At a time t_2, when the short circuit current is equal and opposite to the steady current, rectifying element A ceases conduction; commutation is complete and all the load current has been transferred to the incoming anode B. During the commutating period, the two phase voltages must remain equal and the d-c voltage is equal to the average of the two phase voltages.

When negatively energized grids are interposed between the anode and cathode, or cathode ignition is suppressed, the time at which anodes may fire may be delayed so that the output voltage is reduced. This action is called PHASE CONTROL and is illustrated in Fig. 8 (c). The notches of lost voltage are larger so that the average d-c voltage is lower.

If the current transfer is delayed by phase control, the phase difference of voltage which is available for commutation increases as the current wave on any phase lags more and more behind the voltage wave. Advancing the current wave ahead of the voltage wave results in a difference in voltage to oppose commutation. Therefore, phase commutation in a rectifier will operate only in the lagging quadrant or when the power factor of the load drawn by the rectifier is lagging.

The grid controlled rectifier may be operated as an inverter by reversing the d-c connection and providing suitable excitation for the grids. The connection diagram for a phase commutated inverter is shown in Fig. 9 (a).

The operation of the circuit may be explained by referring to Fig. 9 (b). At the instant t_1, e_1, the instantaneous voltage of phase X_1, is less positive than e_2, the instantaneous voltage of phase X_2. Therefore, the current entering an inverter against the counter e.m.f., of phase X_1 will be transferred to phase X_2 by the instantaneous difference in the voltage. Moreover, current transfer will take place in the proper direction only on the leading side of the voltage wave, since the rectifying elements will conduct current in only one direction.

The flow of power from a d-c system or rectifier to an a-c system requires that the anodes carry current when transformer voltages are negative, so that anode currents flow in opposition to the voltages of the a-c system. In the inverter this is accomplished by controlling the start of anode conduction by means of grids.

Referring to Fig. 9 (c), anode A carriers current during the time its transformer voltage is negative. The other anodes are prevented from firing by the negative excitation of their grids. The transfer of current from anode A to anode B is initiated by exciting the grid of anode B. Since the grid controls only the start of conduction, commutation must be started while the potential of anode B is more positive than that of anode A. In order for the current to be commutated successfully, it is necessary for conduction in anode B to be initiated early enough so that commutation and deionization is completed before the anode voltages equalize. This means that the angle of advance must always be greater than the time u required for commutation. This commutating requirement is the basic difference between the controlled rectifier and the inverter.

There are two serious limitations of phase commutation as applied to an inverter:

(a) An inverter employing phase commutation cannot supply lagging kilovolt-amperes.

(b) Any delay in the commutation of current results in insufficient commutating voltage and a failure of the rectifying elements to transfer current.

Harmonic Commutation

Shown in Fig. 10 (a), are the inverter voltage waves for phases X_1 and X_2 with a superimposed third harmonic. At the instant t_1, e_2 is more positive than e_1, and, therefore, by distorting the voltage wave by a superimposed harmonic the instantaneous difference in phase voltage may be such as to produce commutation even in the lagging quadrant. This method of producing commutation is called Harmonic Commutation.[5]

The single-phase harmonic voltage is usually introduced through a commutating transformer, as indicated in Fig. 10 (b). The harmonic single-

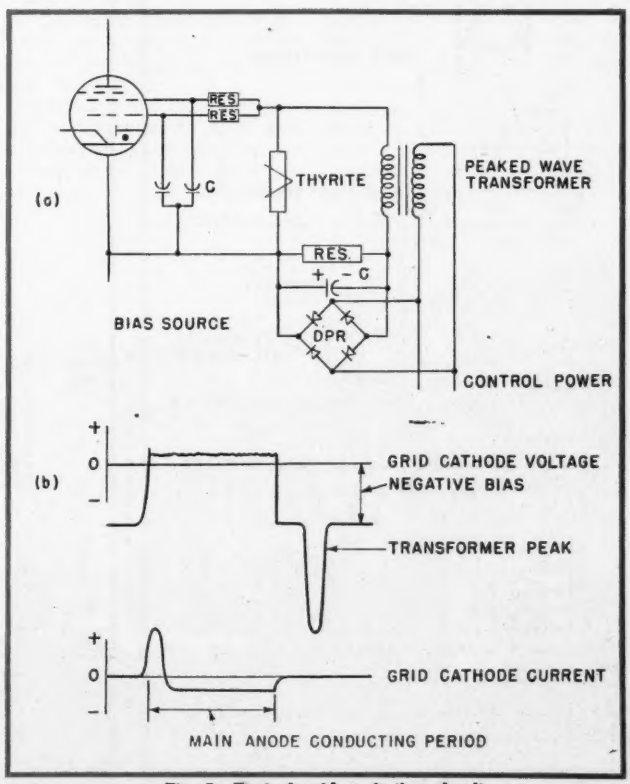


Fig. 5. Typical grid excitation circuit

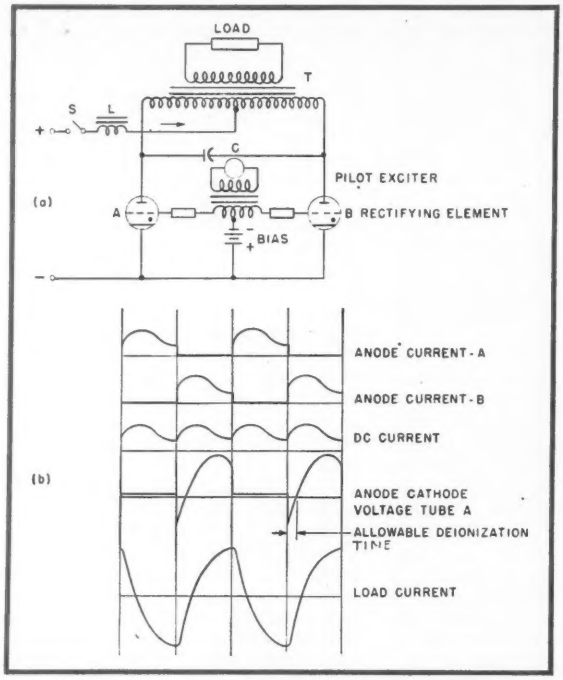


Fig. 6. Parallel capacitor commutated single-phase inverter—resistance load

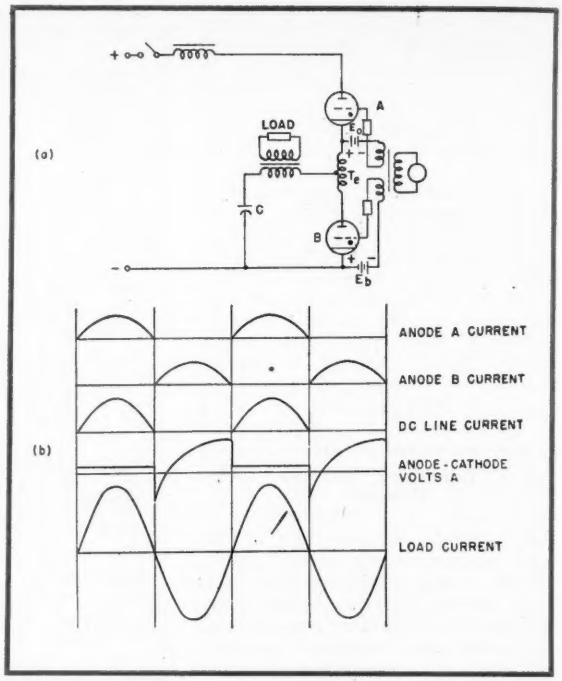


Fig. 7. Series capacitor commutated single-phase inverter—resistance load

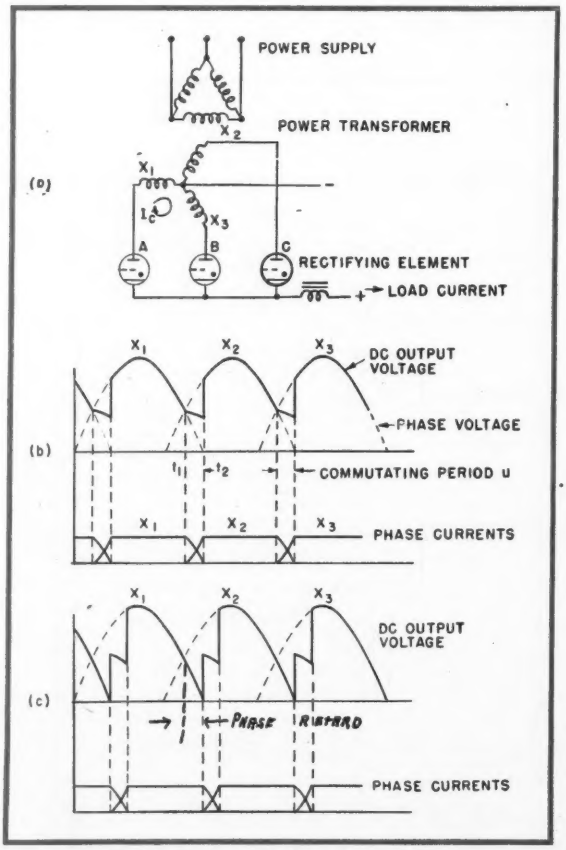


Fig. 8. Elements of phase commutation

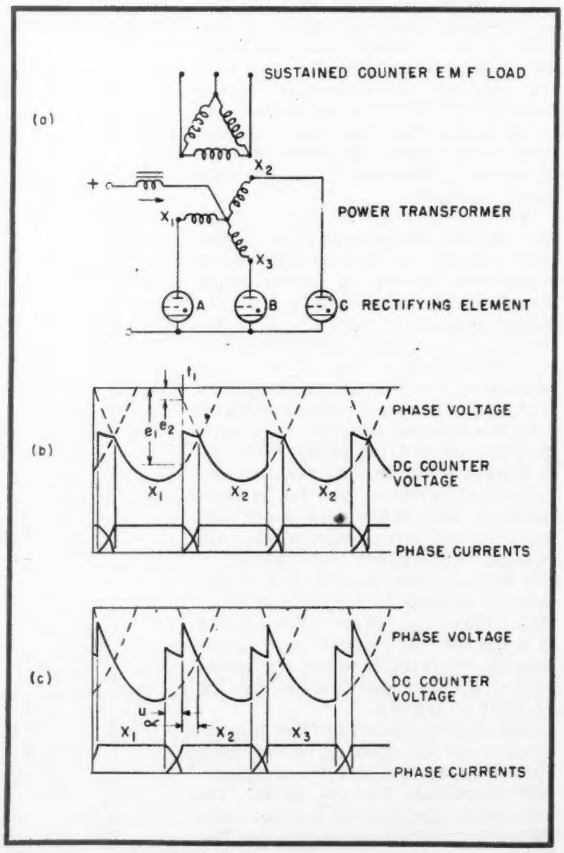


Fig. 9. Phase commutated inverter

phase voltage may be supplied from any convenient source, for example, a generator or a capacitor bank connected across the terminals of the commutating transformer. When a capacitor is used, a harmonic of triangular wave shape is supplied by the d-c current and has an amplitude proportional to load current so that the commutating angle is automatically increased with load.

Electronic Frequency Changers in Industry

D-D-LINK TYPE

When the d-c power for the above types of inverters is supplied from a rectifier, the equipment is an electronic frequency changer of the d-c link type.[6] Figure 11 shows the external appearance of a 20,000-kw equipment for interchanging power between a 60-cycle and 25-cycle power system. The terminal power circuits are identical except that the grids of the rectifier are excited at input frequency f_1 and the grids of the inverter are excited at output frequency f_2. With phase commutated types, the rectifier and inverter circuits are independent of one another and offer the advantage of reversibility by change of grid excitation.

From Fig. 9 (c), it may be noted that the phase position of the current is ahead of the phase voltage. This means that the receiving a-c system must supply leading reactive voltamperes, not only to connected inductive load, but to the inverter as well. Another requirement of the receiving system is that it must supply the wave form of the phase voltages to commutate the current. The reactive kilovoltampere requirement of the inverter may be provided by a-c generators or over-excited synchronous machines connected to the receiving system, hence this system is not well adapted for stub feed.

Control of power flow through the electronic power converter is responsive to phase-control on either the rectifier or inverter. Retarding phase position of the rectifier grid excitation lowers the d-c applied voltage to decrease the power flow. On the other hand, retarding the angle of the inverter increases the counter voltage also resulting in decreased power flow.

COMPOSITE TYPE

In the composite type of frequency changer one set of rectifying elements performs the combined functions of rectification and inversion. An equipment for the conversion of 60-cycle, three-phase power to 1000-cycle single-phase power for induction heating provides a good example. Fig. 12 shows a delta, three-phase, zig-zag power transformer operating at supply frequency f_1 and having secondary terminals X_1, X_2, and X_3 connected to three parallel capacitor commutated inverters operating at 1000 cycles. The cathode return is connected to the supply transformer neutral N through a reactor L, which serves to isolate frequency f_2 from the supply transformer.

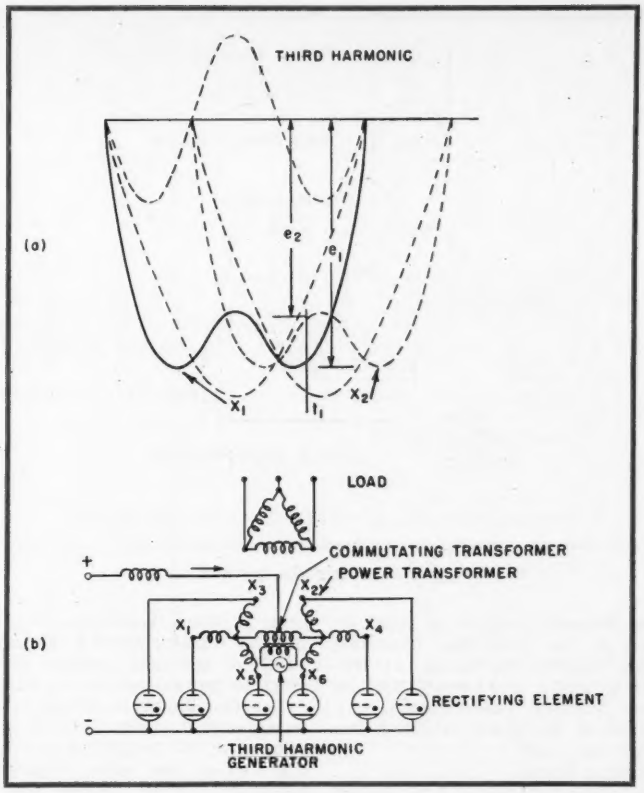


Fig. 10. Elements of harmonic commutation

The operating principle of the single phase inverters A-A′, B-B′ and C-C′ is the same as for parallel capacitor commutated type. Each inverter operates in phase sequence at 1000 cycles as the transformer terminals X_1, X_2 and X_3 become positive. Rectifying elements A-A′ operate when X_1 is most positive, and commutate to B-B′ after 120 degrees of the supply frequency in the same when X_1 is most positive, and commutates. The circuit has the advantage that commutation failures at frequency f_2 are automatically put out by the supply frequency f_1.

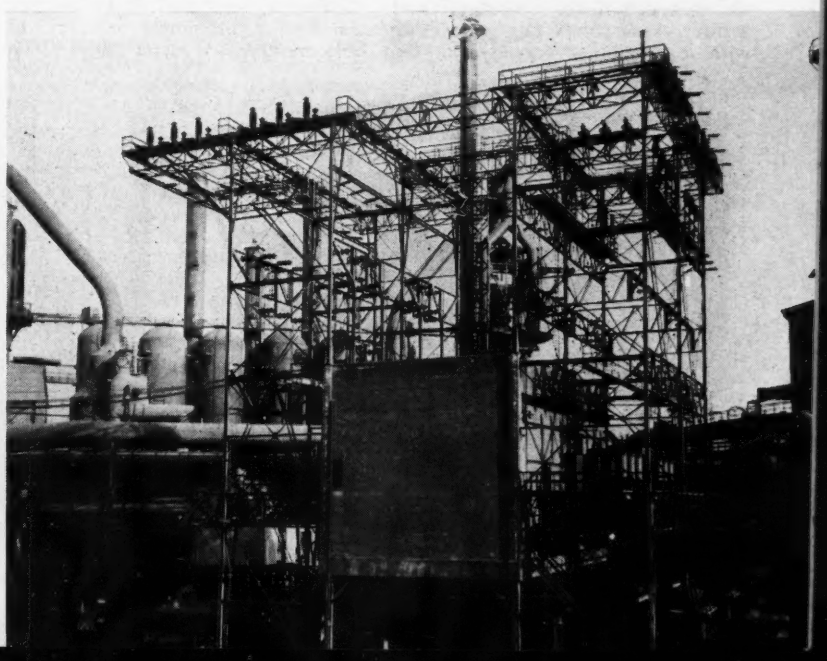


Fig. 11. External view of a 20,000-kw electronic frequency changer for transfer of power between a 25 cycle, 44-kv system and a 60 cycle system

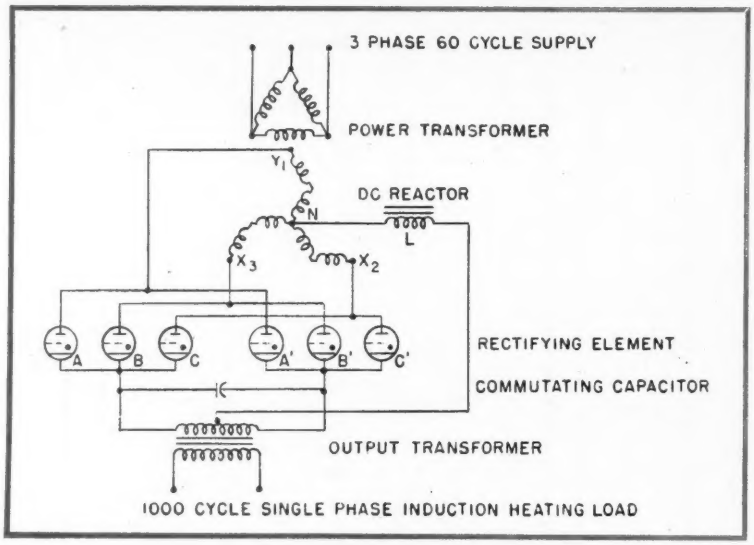


Fig. 12. Composite inverter

Dual frequency excitation must be applied to the rectifying elements, namely, rectifier excitation, at frequency f_1, and a frequency f_2 for the inverter function. Power control may be obtained by phase shifting the rectifier excitation.

Electronic Motor

The "electronic motor"[7] is another example of the composite type frequency converter wherein the rectifying elements perform dual functions. Figures 13 and 13-a show an early motor of this type with associated control, used to drive an induced draft fan in a steam generating station. Here the combination acts as a frequency changer to reduce the frequency.

The operation of this type of motor may best be described by reference to Fig. 14, which shows the power-circuit diagram of a three-phase series-excited motor operating from a three-phase power supply, together with a distributor for exciting the grids at motor frequency and a phase shifting transformer for shifting the phase of the grid voltage with respect to the voltage of the supply.

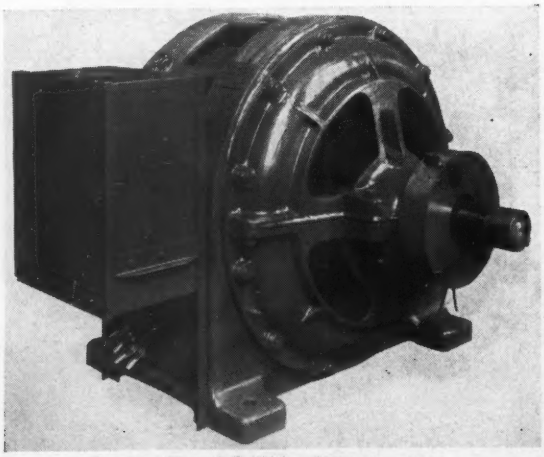
The distributor is driven synchronously with the motor and the angular position of the brushes is so adjusted that when the coils representing phase X_1, of the motor are symmetrically beneath the north motor poles, the brush, (a), is centrally located on the segment of the distributor to excite the grids of rectifying elements A, A′ and A″ which are connected to phase X_1 of the motor. In a similar way the brushes (b) and (c) are connected to elements B, B′ and B″, and C, C′ and C″ respectively.

For every position of the motor armature there will be three rectifying elements whose grids will be excited at supply frequency through the distributor and the phase shifting transformer. A simple rectifier will be connected to a motor phase which is in position to produce torque when conduction is established in the rectifying device. It will be assumed that the starting position of the motor is as shown with the grids of elements A, A′ and A″ excited through brush (a). Rectified current then flows through phase X_1 and the motor field. By phase control, the rectifier may be adjusted to give any desired current through the motor. As the coils of phase X_1 move out from under the poles, brush (a) of the distributor moves off the segment so that rectifying devices no longer conduct and the current in X_1 phase will be reduced to zero irrespective of the starting of another phase. However, the segment moves to brush (b) making rectifying elements B, B′ and B″ conducting, imposing the same average voltage on phase X_2 as was just previously impressed on phase X_1. In this way, each phase conducts current for 120 electrical degrees.

If the current through the armature is greater than that necessary to overcome the load torque, the motor will accelerate and thereby increase its counter e.m.f. which will oppose the flow of current. Equilibrium will thus be obtained between the impressed voltage and the counter e.m.f. by a change in speed. The performance characteristics are much the same as those of a direct-current machine; but the electronic motor has the advantage that the applied voltage may be changed by phase-control to give speed adjustment or current limitation on starting.

The rectifier phase commutating process caused by the electro-motive force in the supply circuit is adequate for speeds up to about half the synchronous speed of the motor at supply frequency. For higher speeds, inverter phase-commutation, timed by the distributor, takes place as a result of the electromotive forces in the motor circuit.

Electronic frequency changer power circuits are subject to a variety of



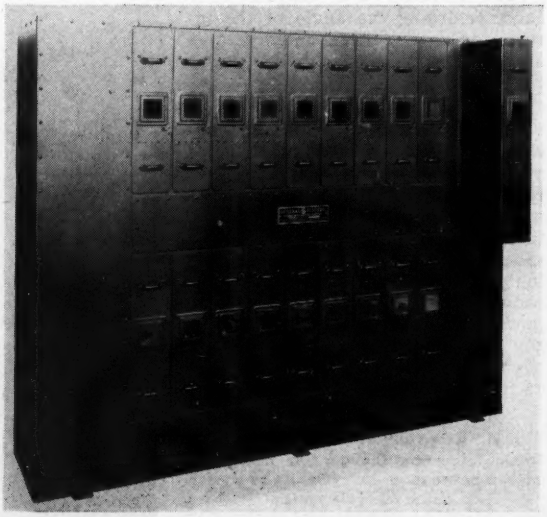


Fig. 13. (Above) A 400-hp, 625-rpm motor
Fig. 13A. (Right) Electronic motor control associated with the 400-hp, 625-rpm motor shown in Fig. 13

arrangements, each having advantages and disadvantages for a given application. In many fields, the electronic equipments offer a higher efficiency, ease of control, and a flexibility not attained by other forms of converting equipment, but are subject to limitations imposed by the requirements for commutation. An understanding of the basic principles of commutation and the proper evaluation of the advantages and limitations are necessary to insure sound applications of electronic frequency changers.

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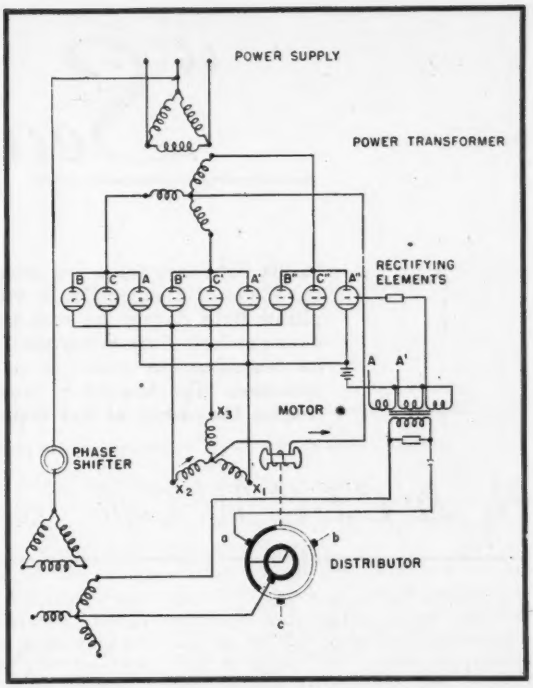

Fig. 14. Elementary diagram of an electronic motor

Recent Developments in Illumination

SUNLIGHT, 24 hours a day and independent of the weather, is now a possibility. Through the use of the latest developments in the field of illumination, the sun's radiation has been duplicated in the Lighting Institute at Nela Park, Cleveland. Combining the radiation from fluorescent, mercury, sun, and incandescent lamps, engineers were able to produce an artificial sunlight visually indistinguishable from the real thing—complete with tanning and warming effects—but the fact that about 100 kilowatts of power are required for an area the size of an average private office suggests that artificial sunlight may be restricted to a very few installations in the immediate future.

Using a new phosphor, fluorescent sunlamps were introduced to bring the advantages of sunlight indoors economically. Only standard fluorescent auxiliary equipment is required. One type, for use with poultry, has 75 per cent germicidal and 25 per cent erythemal (tanning) radiation. Another type, in 20- and 40-watt sizes for personal use, produce only suntanning erythemal energy. It is estimated the new 40-watt sunlamp is 15 times as effective per watt of input energy as the well-known S-1 lamp in production of erythemal radiation.

Split-second starters for fluorescent lamps were created, eliminating the warm-up period common to most fluorescent installations. Circline fluorescent lamps became the inspiration for new designs of portable lamps for the home and of decorative fixtures in commercial applications. Some lighting engineers estimate that 75 per cent of the uses for the circular lamps will be found in homes.

Development of a new white fluorescent lamp having a color temperature closer to that of daylight than that of the 3500 deg. white lamp—and more flattering to the complexion than the daylight fluorescent lamp—was announced. It emits more warm red. Also new was a low-brightness, 40-watt, 4500 deg. white, 60-inch fluorescent lamp which requires less shielding since it has a brightness only slightly more than half that of the standard 40-watt fluorescent lamp.

A thick rubber skirt was the answer when it came to making rough-service lamps withstand the shocks demanded by Navy service. The 50-watt lamp consists of a filament similar to that used in the standard rough-service lamp and a special globe-shaped bulb securely mounted in a thick rubber skirt on which in turn is mounted the medium screw base. Such lamps were supplied for use on special emergency lighting circuits to prevent darkness from halting operations below decks at critical periods.

Christmas tree lamps again rolled from the machinery late last year—from machinery which during the war had been switched from the production of cheerful colored bulbs to the deadly serious business of forming a basic part of the radio-operated VT fuse. Mass production of the fuse called for large quantities of a small glass ampoule filled with acid and sealed. Similarity of production problems of the ampoule and Christmas tree lamp was apparent, and the lamp machinery was converted.

Sealed-beam landing lamps for large and small private planes were announced, following their successful war operations. This type of construction, originally used for automobile headlights, was also applied to a lamp for farm tractor lighting and to a clear-glass, shielded filament, spotlight lamp.

The repeating flash tube played a leading role in night aerial photography from reconnaissance planes over enemy territory. Powered by a special electronic source, a coiled quartz tube emits flashes of illumination of an intensity making night photographs possible from altitudes up to two miles. Plans for postwar uses of the tube call for applications in airway and waterway beacons, as well as in photography.

A 375-watt heat lamp was introduced as a companion to the standard 250-watt lamp in industrial drying applications, to permit a 50 per cent increase where needed in watts per square inch with the same spacing arrangement.

That old source of annoyance, light shining in through the bedroom window, was eliminated in two newly designed luminaries for suburban street-lighting installations.

"Seapower"

In the February issue we presented an article by W. N. Oberly of the General Electric Co. in which he described the floating power plants built during the war for supplying emergency power wherever needed. Now, we present this article by Lt. Col. Cutler in which he describes the operation and performance of one of these units overseas. The towing of these power barges across the Atlantic during the worst of the stormy seasons was a remarkable feat

*By Lt. Col. C. W. Cutler** **Corps of Engineers**

DURING the darkest hours of the war when nothing but strategic withdrawal had been the lot of the allies everywhere, the Corps of Engineers was teaching its officers how to destroy equipment to prevent its falling into the hands of the enemy. Among these teachings was the destruction of electrical generating and distribution equipments and facilities. Notwithstanding this, the great will-to-win also inspired the leaders to plan what would be done about it if the enemy were to destroy in a similar manner when eventually forced to withdraw inward.

Among the counter measures planned was the furnishing of countless portable gasoline and diesel driven generating sets, (the most popular sizes being 50-60-75 and 100 kw) railway mounted power trains (usually 5000-10,000 kw capacity) and floating power plants 30,000 kw capacity of which there were eventually three for military use. It is about these floating power plants that this article is written.

There had previously been planned four barges 318 ft long to contain generating plants of 30,000 kw capacity for use by the War Department on inland waterways of the U. S. Two of these barges had been launched and tested.

At this point it was decided that the next plant would be seagoing for use in foreign theatre by the armed forces. It was equipped and manned with this in mind. As it came off the ways, it was christened "Seapower."

The Seapower should be of interest because of what it is, what its performance has been, its manpower requirements and what its advantages and drawbacks may be. In it may lie the seeds of future engineering ideas adaptable to peacetime design entirely aside from whether the unit is afloat or a land installation.

What it is

In one sense it is a packaged power plant pre-tested and delivered by water to its location ready for operation. But in its avowed purpose, the Seapower was a fighting machine.

The hull, after adding a bow to the design, was 358 ft long by 50 ft beam

* Formerly Commanding 1496 Engineer Unit.

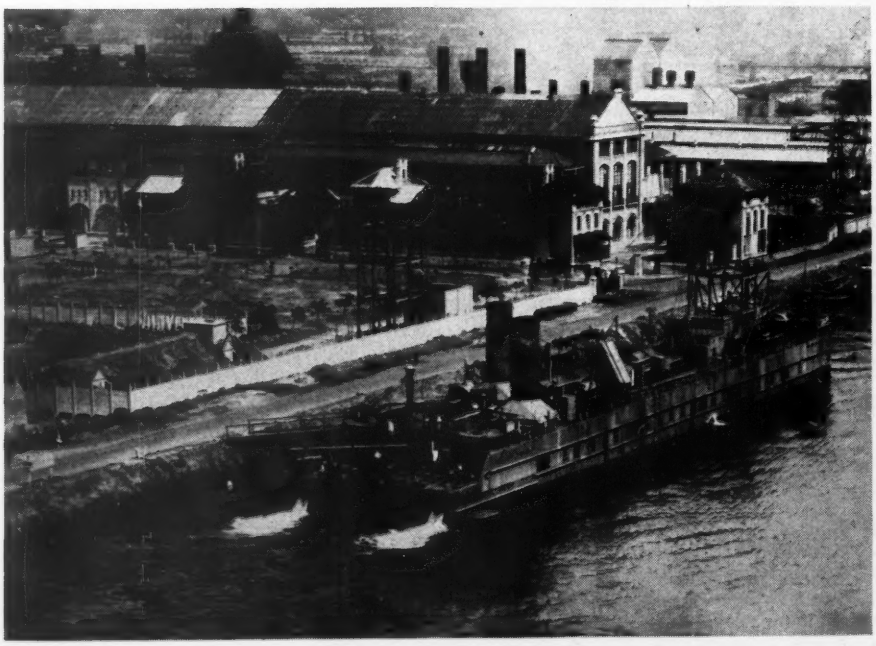

Fig. 1. "Seapower" at Langerbrugge near Ghent, Belgium. Fifty cycle power was delivered at 12,000 v to the 70 kv Belgian network through existing substation. "La Centrale de Langerbrugge Power Company Centrales Electriques des Flanders et du Brabant" shown in background

(wide). It was flat bottomed, drawing 8 ft minimum draft with a full load of water but no oil in its tanks. When loaded with 385,000 gal of fuel oil and fully equipped with tools and supplies for a year's isolated operation, the draft was an average of 12 ft.

In this hull was housed the necessary equipment to generate and deliver an output of 30,000 kw, 3 phase, 60 cycle power.

The principal equipment[1] consisted of the following main parts:

2—Babcock & Wilcox water tube boilers each consisting of saturated and superheated sides with a superheater placed vertically in the center between the two sides. Preheaters and economizers were installed in the upper section over the saturated side. Each boiler was rated 170,000 lb per hr at 850 psi and 925 F.

9—Oil burners per boiler, three on the saturated and six on the superheated side.

2—Bailey meter boiler controllers, one for each boiler.

1—General Electric Co. turbo generator set consisting of:
- 1—19 stage 825 psi 900 F four point extraction turbine driving,
- 1—30,000 kw-13,800 v, 3 phase, 60 cycle, 3600 rpm hydrogen cooled generator also rated 25,000 kw-11,500 v, 3 phase, 50 cycle, 3000 rpm.

1—Frequency changer 1500 kw, 50 to 60 cycles for supplying 60 cycle power to the house load when the plant is operating at 60 cycle output.

1—440 v-bus room containing remotely controlled G. E. draw-out breakers for all auxiliary power circuits. The 440 v-bus was supplied through two 13,800/440 v, 3 phase, 60 cycle transformers.

1—Main switchboard, General Electric.

1—Turbine gage board.

1—Westinghouse 13,800/6900/138,000 v, 3 phase 60/50 cycle Nitrogen protected, oil filled step-up transformer.

All other necessary parts to make up a complete plant including station and ships auxiliary were supplied.

Movement Overseas

The movement from Pittsburgh, Pa. (the point of outfitting) down the Ohio and Mississippi Rivers to New Orleans, thence around the coast of Florida, across the stormy Atlantic, through the English channel and into inland Belgium was an historic one.

The trip down the Ohio and Mississippi Rivers was 1800 miles of calm and beauty. The channel depth indicators were reading 8 ft 3 in. at spots and the draft on the aft end was 8 ft 3 in. The previous plant had grounded three times on its way down the same course, but this time thorough preparations brought an uneventful journey.

[1]For a full description of the Seapower equipment, see an article entitled High Pressure Floating Power Plants, published in the September, 1945, issue of Marine Engineering and Shipping Review, by Gielow, Inc., Naval Architects. Also see Floating Power, Power Plant Engineering, February, 1946, p. 66.

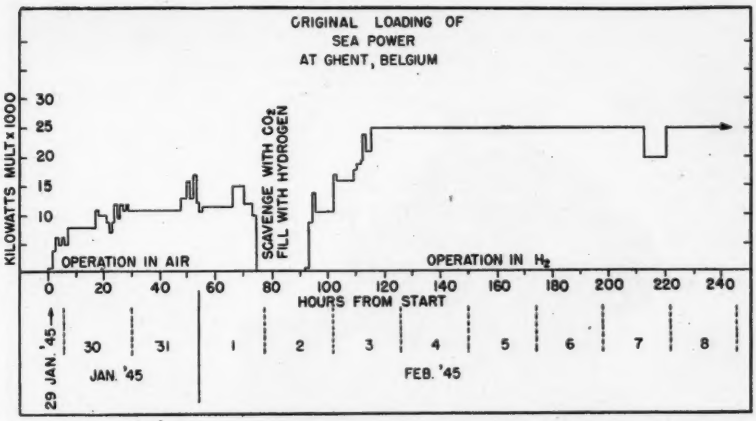

Fig. 2. Chart showing original loading of "Seapower" at Ghent, Belgium

At the New Orleans Port of Embarkation, it was checked for rigging, stowed and made ready. In early October it was towed down the channel and out to sea. From that time on no holds were barred. It almost seemed that the Furies were in league with the enemy in an attempt to prevent the Seapower from arriving on time.

The equipment included one life boat and two rafts. It was considered wise to take only a skeleton crew, the remainder of the men to go by troop transport for safety. It should be remembered that this was a great flat bottomed hull with highly concentrated loadings, due to the large machinery installed. This design of hull had never before been put on the high seas. It was headed out across the Atlantic in the worst of the stormy winter seasons and this it truly proved to be.

During early October it skirted the Gulf and 20 days later, after encountering a hurricane, arrived in Charleston harbor. Here it was joined by a similar unit, which had been converted from one of the earlier 318 ft units, and after making up in convoy began the long trek across the stormy Atlantic.

Twenty-eight days later, after rolling and tossing, it came into the Downs with seawater in a number of the oil tanks and with a number of splits in the weather deck. The crew, most of whom had never been to sea before, were magnificent in spite of seasickness and frayed nerves. As for the plant, it stood the strains and the equipment could be considered as coming through without damage due to the crossing. While the weather deck plates did split in some places, the framing showed the forethought placed in it by the designers. Since all equipment was of a design intended originally for land installation, the effects upon it of a long arduous sea voyage may be of interest.

The boilers behaved in grand shape. In spite of the roll of as much as 30 degrees and days of a heavy quartering sea, the settings were in perfect condition. There were twelve tubes that needed re-rolling to prevent "sweating" when 1500 lb hydrostatic test was placed on the boiler. Otherwise no indications of strain existed.

The turbine, the generator, the switchgear and the transformers showed no distress. The only item was the cracking of one cooling wa-

Table A

Point	Kw Load	lbs/Kwh	Hours run	Date
1	12,000	.737	3	24 February
2	13,000	.68	5½	1 March
3	20,000	.74	5	22 February
4	20,000	.70	15	18 February
5	25,000	.67	24	11 February
6	25,000	.68	14	17 February
7	25,300	.688	3	23 February
8	25,500	.734	57	5-7 March
9	27,000	.688	11	21 February
10	27,000	.715	8	22 February
	27,200	overload valve begins to open.		

Note: For 28 days of February the plant used 10,755,350 lb of fuel and delivered 14,680,000 kwh, an average overall rate of 0.73 lb per kwh.

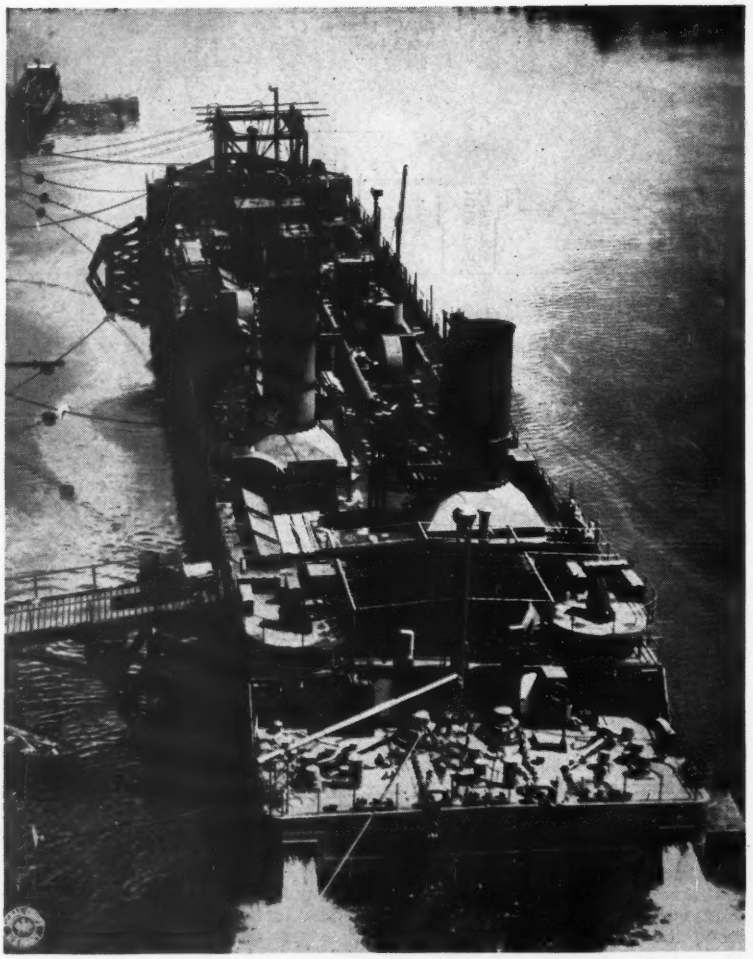

Fig. 3. Good combustion was an important factor both for operational and navigational reasons. All shipping traffic for what was the Allies second largest northern port passed within two hundred feet of this point

ter pipe joint under the generator, which was quickly repaired.

By the time the Seapower had moved across the Channel, up the Schelle River and into position, the crew had everything in readiness to perform. Four days after spotting in location, the power lines were up and electric power was delivered ashore to the Belgian system. (See Fig. 1.) Figure 2 shows the ease with which the plant came up to load. It responded to the will of the operators without a single hitch or cause for delay. Its freedom from difficulty was so complete as to surprise even those who believed it ready to go into action.

Performance

In discussion of the overall efficiency performance of the plant, certain limitations should be sighted. Basically, there was a slightly larger heat loss from the hull due to the long narrow layout and also due to the intimate contact with the cold water at certain seasons of the year. Then too, there was a slightly increased usage of power for servicing and quartering of the large crew of men, which lived aboard continuously.

Conditions of operation at the start were not conducive to good test runs due to the necessities of war. But as the Belgian network began to function more normally, the character of the load was changed. The objective shifted from immediate delivery of power to the saving of coal.

It was at this point that ideal conditions for tests developed. The plant was able to choose a block of load and hold that load 24 hours per day for days at a time. Weather conditions were settled and no storms interferred. But complications stood in the way of exact methods of short time heat balance tests. Meters existed in all important intermediate locations for a complete heat balance, but no methods of calibrating the intermediate flow meters and other intermediate instruments existed other than by comparison and analysis. For the overall oil to wire runs, methods were available.

The Central Electric of Flanders Power Company offered to calibrate the outgoing integrating electric watthour meter. The oil flow meter was calibrated by "sticking" the tanks into which oil was pumped. Temperature tests were also run on the oil to establish a weight volume curve. These were compared with British Engineering Laboratory tests on the same oil.

With the input of oil known and the output meter proved accurate, an oil to wire test was undertaken.

Correction for weight of oil pumped were made and pump errors accounted for by stick comparisons with integrated readings. The total errors are believed to be plus or minus 3 per cent. No claim is made to laboratory accuracies, as these tests were a bi-product of a mission.

Tests on the oil were made by the British Engineers. From their laboratories came the following specifications in part:

Btu/lb 18450 to 18650
S. Gr. 0.949
Flash Point 210 F
Conradson Carbon Residue 3.20%
Sulphur Content 1.4—2.0%

Test Summary

The results of test were obtained as follows: The plant operated continuously for long periods at steady load. When conditions became settled, careful control was instituted over a given period and this portion of the run lifted out as a test datum. Table A gives a summary of these results. No attempt is made to go into the refinements of reducing these to guarantee conditions or even to adjust the results to a common condenser pressure, which varied from 1 in. to 1.5 in. of mercury.

It may be of interest to list a little more fully the results of point No. 8 from table A. Since this falls so close to the average for the month, and since it is by far the longest listed run, other data is given on the basis of this point only.

Pounds of fuel.....1,067,000
Oil pumped at.....52 to 74 F
Kwh 1,457,000
Kw line 25,500
Length of run.....57 hours
Steam Pressure ....825 lbs (turbine)
Steam Temperature.900 deg (turbine)
Exhaust press.....1.3 inches Hg
Pounds oil kwh line.....0.734
lb steam per lb fuel.....
.....13.85 (uncorrected)
lb steam per kwh line.....
.....10.15 (uncorrected)
lb water per lb fuel.....
.....14.45 (uncorrected)

Note: Higher efficiencies than these have been reported on original test runs of a similar plant (using other oil and other conditions).

Operating Limitations

Usually operating limitations, which develop in a plant of this kind can be traced to conditions not accounted for in the original specifications or through force of circumstances under which the plant has to operate.

The most important of these appeared in the boilers. These boilers were designed for light weight and small space. It appears that in conditions encountered, the oil actually burned had more non-combustible residue than was anticipated when the layout was made. Full soot blowing equipment was used every eight hours. But in spite of this, the superheater passages were 50 per cent choked up in a run of 60 days. A routine was, therefore, established, taking alternate boilers off for cleaning every 30 days. This cleaning process took from 60 to 72 hr for cooling, hand lancing and coming back up. The plant remained on the line continuously but for 72 hr of each month, the output would drop back to about 15,000 kw while one boiler was out of service for cleaning. Longer periods of operation between cleanings would have been unsafe for the equipment considering the oil burned.

Another limitation of design arose in the operation of the make-up evaporator system. Low pressure steam was taken from a 30 lb extraction point of the main turbine. This steam was passed through heating coils of two make-up water evaporators. These evaporators received seawater and delivered 5 to 10 lb steam to a vertical type evaporator condenser. The cooling medium for the condensation was the water returning to the "Dearator" from the turbine hot wells.

It was found that there was insufficient condensate return from the hot wells to cause the evaporator condenser to function, when the kilowatt load on the main generator was below 10,000 kw. This performance also tied in with the extraction point on the turbine, which furnished 30 lb steam to the evaporators.

As a net result, the house load was insufficient to allow production of distilled makeup water so necessary to the safety of main boilers and equipment of this plant. During the hydrostatic tests on the boilers and during the initial firing, care had to be exercised to preserve condensate and to protect the boiler water purity.

The method used was to ballast the boilers and storage tanks with distilled water and treat this to 20 ppm for wet layup before leaving the U. S. When ready to start, hydrostatic tests were made with this water. Fortunately only two fillings were needed, as the rolling of tubes was successful after one opening.

The boilers were fired with the water at 20 ppm. The load was brought up to 10,000 kw as quickly as appeared safe (see Fig. 2) and new water produced for dilution. Frequent blowdown and continuous boiler water and feedwater tests were utilized as controls. Under normal conditions where fairly pure shore water is present, this might not be considered important. But where usable makeup was not available, as in this case, danger existed that the condensate might be expended.

Still a third interesting problem arose at the initial start. The plant was anchored in low temperature canal water. Its initial load of fuel (American bunker "C") was in the bottom tanks. The oil "froze" and could not be handled by the gear pumps. Fortune again smiled on the operation, in that the settling tanks were full and above water level. This was sufficient to allow a start and thawing of one tank at a time to "lay down the road" ahead of operation.

A fourth problem was the common one of ever present fish. These were in general about two inches long and infested the European rivers and canals by the millions. It was found that these were near the surface of the water and that by keeping the intake low in the canal, most of this nuisance disappeared.

Recovery

The capacity of a plant to recover its load after a "trip off" is of significance where the unit is to ride a rough system. It might be stated very roughly that when the load was dumped from a stable full load condition and the forced draft fans allowed to continue to run, the following results in recovery existed:

1. Zero load persisted not longer than 5 min, load could be resumed as fast as desired.
2. Zero load persisted not longer than 10 min, load could be brought back within 30 min.
3. Zero load persisted for 15 min, load could be brought back within 45 to 60 min.

Such matters depended to some extent upon whether the forced draft fans could be shut off, with attendant "pop off" and loss of condensate. These boilers having lightweight settings and relatively large percentage of steel would naturally be somewhat different than heavier land installations.

Rolling Reserve

These plants were equipped with only one turbine. Considered as an isolated unit, there was no rolling reserve. The entire plant itself could be considered as rolling reserve to a larger system. It was in this capacity that it functioned.

Manpower

Here again, the mission influenced the size of the crew. The basic functions of the crew as a fighting machine were:

1. To *operate* the plant (a highly specialized job).
2. To be trained for electrical shore duty.
3. To protect the ship against land attack to maintain guards and sentries 24 hrs per day.
4. To man four anti aircraft deck guns at a moment's notice when needed.
5. To be able to join other land combat units as infantry in case of loss of plant.
6. To furnish deckhands trained to handle the ship, the ship's equipment, its oil tenders, its service dory and life boats.
7. To furnish personnel to operate the ship's mess, laundry, and housekeeping establishments.
8. To furnish in addition, construction, repair and machine shop men, electricians, switchgear trouble shooters, fire fighting, degausing and radio men.

The crew to do all this consisted of 55 men and four officers. Jobs had to be overlapping and each man had to be a candidate for fill in, should a substantial portion of the crew be lost. In civil life a much smaller component would be permissible as many of these duties would not exist.

Conclusions

The Seapower was used as a supporting power unit over a relatively short period. It generated and delivered 4¼ million kwh per week or a total of over 71 million kwh net power to shore installations. Its condition remained excellent and its performance high.

Its most provocative idea for future design seems to be expressed in the package or "group unit" engineered block of power. It had its limitations as well as its good points. They were a part of those compromises and expediences necessary to get there with what was necessary in time to win the war.

Davis Dam and Power Plant

BUREAU OF RECLAMATION, Kingman, Ariz., will award contract soon for construction of Davis dam and hydroelectric power plant on Colorado River, at point known as Pyramid Canyon, about 34 miles from Kingman and 67 miles downstream from Boulder Dam. Power dam will be earth and rock-fill type, with total length of crest, including concrete spillway structure, of 1600 ft; crest will be 138 ft above river bed, with reservoir to be constructed providing about 1,940,000 acre-ft. Power station will be located on Arizona bank of Colorado River; water will be delivered through five 22-ft dia penstocks connecting with forebay. Station will be equipped with five 45,000-kw generating units, operated by same number of hydraulic turbines, each of 62,200 hp rating. A 230-kv switchboard will be located on site near generating station, and will furnish service for an extensive transmission system throughout this section of Arizona and Nevada, estimated to cost about $30,000,000, with power substations and distribution lines. Dam structure and hydroelectric power station are reported to cost approximately $47,000,000. Project is scheduled for completion in spring of 1949.

How to Prime Centrifugal Pumps*

By Roy Carter *Application Engineer, Worthington Pump and Machinery Corp.*

Part III . . . Automatically and self-primed units . . . Units with direct connected vacuum pumps . . . Units with separately driven vacuum pumps . . . Systems without vent valves . . . Systems for sewage pumps . . . Time required for priming . . . Why relief valves are used . . . System for air charged waters . . . System for Diesel engine driven unit . . . System for gasoline engine driven unit . . . Priming of steam turbine driven units . . . Controls to prevent operation if not primed . . . Priming systems must suit application

THERE are on the market centrifugal pumps with various designs of priming equipment incorporated to give a self-contained unit. Some of these have automatic priming devices, fundamentally attachments to the pump, which become inactive after the priming is accomplished. Other units, which should be classified as self-priming pumps, incorporate in the design of the centrifugal pump some hydraulic device so it can function as a wet vacuum pump during the priming period. For stationary use, the automatically primed type is favored as it is more efficient; the self-priming designs are usually more compact and favored for portable or semi-portable use.

Self Priming Units

In self priming units the pump design incorporates a chamber or other device, so entrapped water is recirculated and, by means of an ejector action, air can be removed from the suction waterways and discharged into the discharge line. Where the presence of air in the discharge line is objectionable, the automatically primed type of unit would be preferred. Those special designs will not be included in this discussion which covers priming methods and systems applicable to conventionally designed centrifugal pumps. Anyone interested in the portable type of self priming pump will find considerable has been published on this type.

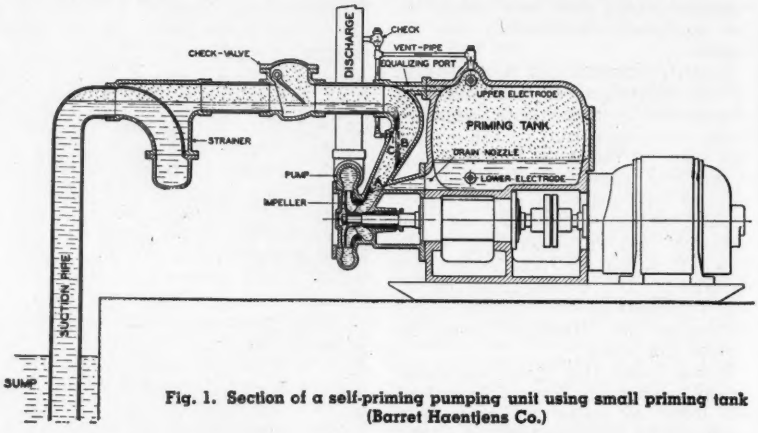

Fig. 1. Section of a self-priming pumping unit using small priming tank (Barret Haentjens Co.)

One interesting combination of a priming tank and ejector action to make a regular centrifugal pump in effect a self priming unit is illustrated in Fig. 1. This consists of a regular centrifugal pump with a priming tank smaller than would be required if a priming tank was used alone. For proper functioning there must be a check valve in the suction line, none in the discharge line, the discharge line must be vertical, and the volume of the vertical discharge pipe must equal the volume of the priming tank and the suction piping to the check valve. When first installed, the pump, the priming tank, the suction line

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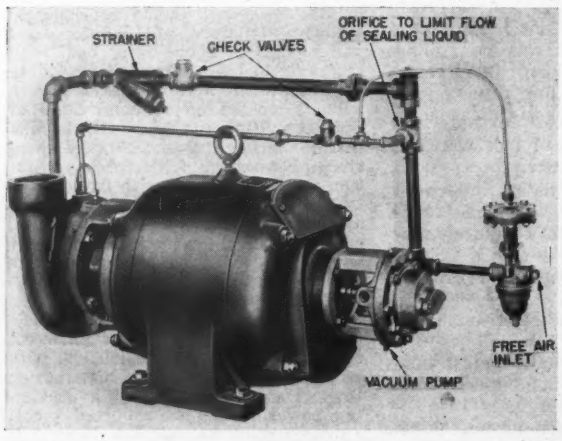
This is the concluding article in this valuable series by Mr. Carter. Part I, which appeared in the March issue, discussed manual priming and various vacuum-producing devices for priming. Part II (April) described central priming systems and various types of automatic priming devices.



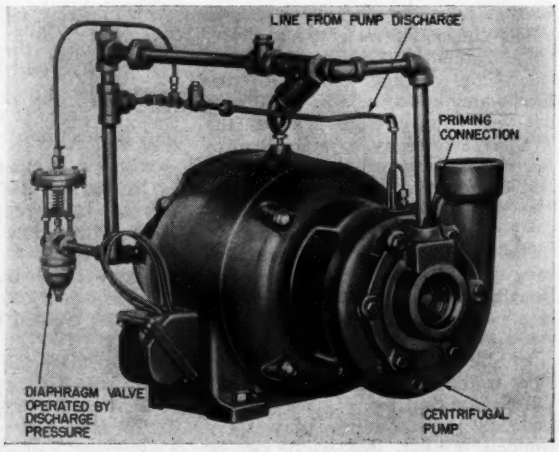


Fig. 2. Automatically primed pump with direct connected vacuum pump (Worthington Pump and Machinery Corp.)

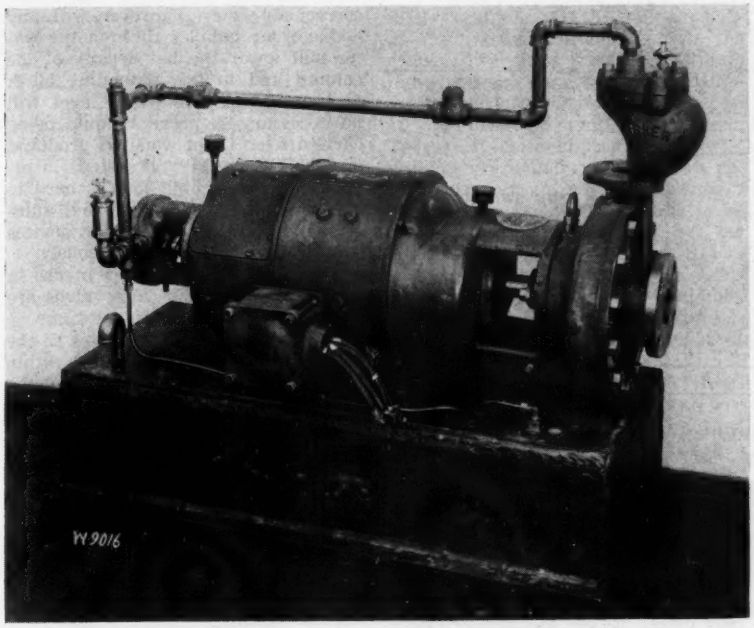


Fig. 3. Automatically primed pump with direct connected vacuum pump (Worthington Pump and Machinery Corp.)

back to the check valve and the discharge pipe up to the same level as the top of the priming tank are filled with water. Two electrodes are installed in the tank and incorporated in the control of the motor so that the unit cannot start unless the water covers the top electrode and so it stops if the water falls below the lower electrode.

Starting the pump causes water to be drawn from the priming tank and the suction line between the pump and the check valve creating a vacuum and causing air to be drawn through the check valve from the balance of the suction line. At the same time the stream of water leaving the drain nozzle traps air of A and carries it into the pump which discharges it with the water. When the water in the priming tank is all pumped out the lower electrode is uncovered and the control stops the pump. The suction line check valve closes and water from the discharge flows back through the pump forcing the air in the priming tank (and suction line up to the check valve) through the vent pipe and its check valve into the discharge pipe until the upper electrode is again submerged. The pump starts again, and more air is drawn from the suction line beyond the check valve. When the suction line has become sufficiently evacuated, and water partly fills the horizontal run as illustrated in Figure 1, the water forms a wall at B which aids in carrying air into the pump. As the horizontal run of suction pipe fills, the flow of water through the pump increases until normal capacity is reached. The flow of water past C draws the air from the priming tank until it is again filled with water. After the prime has been established and all air exhausted from the priming tank, the priming tank becomes inactive. This device permits priming of a system having a larger volume in the suction line with a small volume priming tank. The number of cycles necessary to prime the system depends upon the volume to be evacuated.

The same manufacturer also makes a separate primer to operate on the same principle for use with regular centrifugal pumps.

Automatically Primed Units

In the past decade a large number of automatically controlled priming systems have been developed for attachment to centrifugal pumps. A pump equipped with such a device is called an automatically primed pump.

For most automatically primed motor-driven pumps, a rotary wet vacuum pump, either direct connected or driven by a separate motor, is utilized. With the direct connected vacuum pump type, the controls, which function when the centrifugal pump is primed, open the vacuum pump suction line to atmosphere so that it operates unloaded. With the separately driven vacuum pump, the controls, which function when the centrifugal pump is primed, stop the vacuum pump.

Unit with Direct Connected Vacuum Pump

A typical unit is shown in Fig. 2 with the centrifugal pump mounted on one end of the motor and the vacuum pump mounted on the opposite end thus running all the time. The suction of the vacuum pump is connected both to the vent on the suction of the centrifugal pump and to a pressure operated valve which is closed when the centrifugal pump is not generating pressure.

When the unit is started, the vacuum pump exhausts the air from the centrifugal pump and its suction line until it is primed. When the centrifugal pump becomes primed, it generates pressure and the pressure operated valve opens, allowing outside air to flow into the suction of the vacuum pump. The branch to the centrifugal pump suction vent has a check valve to prevent back flow of air when this occurs as well as a strainer to prevent dirt or foreign material, being carried over to the vacuum pump. The connection from the discharge waterways of the centrifugal pump to the pressure valve is also branched and connected into the vacuum pump suction line through an orifice to provide a small flow of sealing water for the vacuum pump. A check valve is also required in this line ahead of the branch.

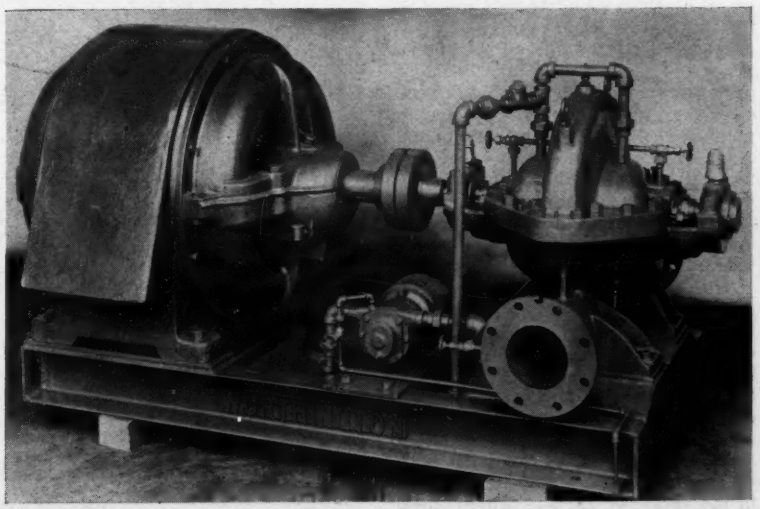


Fig. 4. Automatically primed pump with separately driven vacuum pump (Worthington Pump and Machinery Corp.)

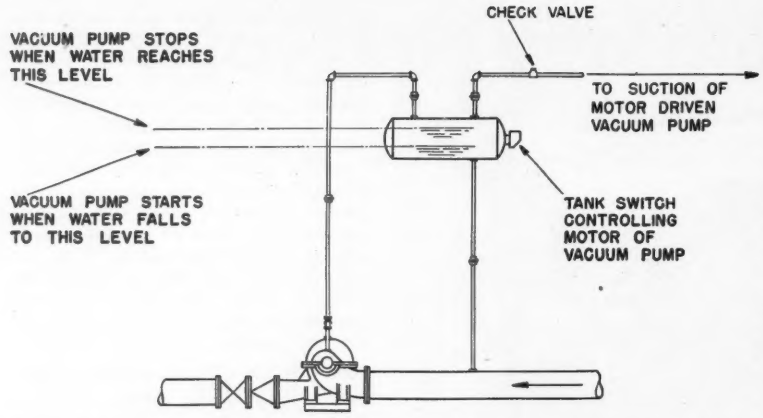

CHECK VALVE
VACUUM PUMP STOPS WHEN WATER REACHES THIS LEVEL
TO SUCTION OF MOTOR DRIVEN VACUUM PUMP
VACUUM PUMP STARTS WHEN WATER FALLS TO THIS LEVEL
TANK SWITCH CONTROLLING MOTOR OF VACUUM PUMP

Fig. 5. . Priming system without vent valves using elevated tank with maintained water level

Another hook-up utilizes a float valve on the vent on the suction of the centrifugal pump. In the particular hook-up referred to, the vacuum line has a relief valve set to open on high vacuum, so the vacuum pump would not be required to pull against a closed suction. It also incorporates a sealing liquid reservoir. A unit of this type is shown in Fig. 3.

Other hook-ups are also feasible such as (1) float actuated valve which shuts off the vent of the pump from the vacuum pump and opens the suction line of the vacuum pump to atmosphere and (2) a pressure switch controlling a solenoid valve in the vent pipe either with a vacuum relief valve or with the solenoid valve being of a three way type.

Unit with Separately Driven Vacuum Pump

An automatically primed pump using a separate motor driven vacuum pump is usually electrically connected so both the main pump motor and the vacuum pump motor start at the same time. The suction of the vacuum pump is connected to vents on the high point of the suction water ways of the main pump and evauates air until the pump is primed. When the pump is primed, it develops pressure and a pressure switch in the circuit of the motor of the vacuum pump opens to stop the vacuum pump. A check valve is necessary in the line from the vacuum pump to the suction vent connection to prevent back flow of air when the vacuum pump is idle. Sealing water is usuall provided from a reservoir in the base.

With this and some other automatic priming systems, it is necessary for the centrifugal pump to run empty during the time required for priming. This is feasible if the clearance between the rings is ample and the size of the vacuum pump is sufficient to prime the centrifugal pump in less than two minutes. In normal service there is generally some water trapped in the volute of the centrifugal pump which aids in lubricating the rings during the priming period. A unit with this type of priming is illustrated in Fig. 4.

Systems Without Vent Valves

When a pump is primed from the suction side it is possible to have the vent piping to the vacuum producer in the form of an inverted loop of sufficient height so the water or liquid being pumped will not be carried over into the vacuum producer. Theoretically it would appear that a loop 34 ft above the water level would be correct for water. However, with any leakage, air bubbles through the water will lower the net density of the column and a loop extending 50 ft or more above the water level will be necessary to prevent liquid being carried over if the vacuum produced is high. Generally, a system incorporating such a high loop is hard to accommodate in a station and automatic vent valves and other devices can be used more advantageously.

There are some systems in use in which risers without vent valves are used and the vacuum producer is controlled by a vacuum device so the water level in the risers is kept within a range which corresponds to the vacuum range. If there is considerable variation in the suction level the height of the riser has to be enough to match the water level in the riser resulting from the maximum suction water level and the maximum vacuum. Naturally the minimum vacuum must produce a water level in the riser slightly above the pump with the minimum water level in the suction supply.

Another system which does not involve the use of a vent valve is illustrated in Fig. 5. This system can be used also as a central priming system to serve pumps taking their suction from the same source.

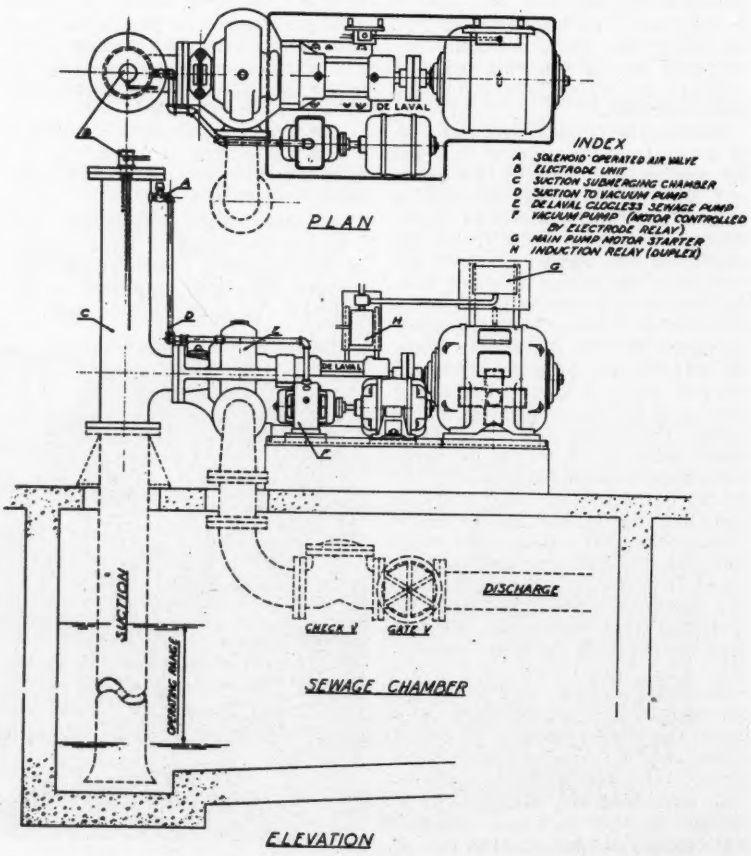


Fig. 6. Priming system without vent valves using riser with maintained water level (DeLaval Steam Turbine Co.)

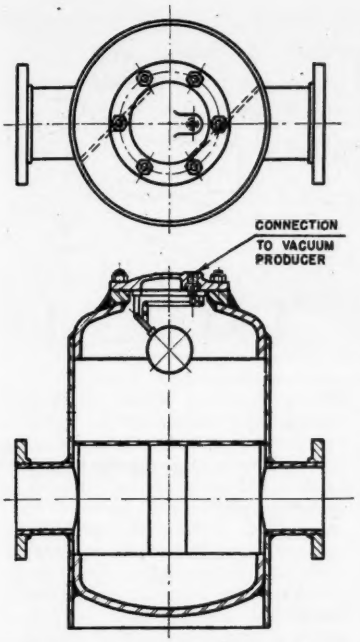


Fig. 7. An air separating chamber for 4 to 12 in. suction lines (Valve and Primer Corp.)

Systems for Sewage Pump

A pump handling sewage or similar liquids containing stringy material can be equipped with automatic priming, however, a special type must be used. One system, illustrated in Fig. 6 for this service uses a tee on the suction line immediately adjacent to the pump suction nipple with a vertical riser mounted on the top outlet of the tee. This riser is blanked at the top thus forming a small tank. In the tank two electrodes are located at different levels. The top of the tank is vented through a solenoid valve to a vacuum system. This solenoid valve is electrically controlled so that it closes when the liquid level reaches the top electrode and open if the liquid level falls below the level of the lower electrode. A third electrode installed at a still lower level but slightly above the pump suction is used to control the pump motor so it will stop if the level falls to the point where this third electrode is uncovered.

The automatic priming system described above and illustrated in Fig. 4, using a separate motor drive vacuum pump controlled by a pressure switch actuated by discharge pressure, has also been successfully used on sewage pumps by incorporating an inverted vertical loop in the vacuum pump suction line. This prevents the sewage being carried over into the vacuum pump because the vacuum pump shuts down before the liquid reaches the top of the loop.

Time Required for Priming

The time required to prime a pump with a vacuum producing device is dependent upon (1) the total volume to be exhausted (2) the initial and final vacuum, and (3) the capacity of the vacuum producer over the range of vacuums that will result in the priming cycle. The actual calculations to determine the time necessary to prime a pump are involved. To permit close approximations, jet primers are usually rated in net capacity for various lifts so it is simply necessary to divide the volume to be exhausted by the rating to get the approximate priming time. Unless such a simplified method of calculating the required time is available, the selection of the size of primer would be best left to the vendor of the equipment.

Central automatic priming systems are usually rated for the total volume to be kept primed. The time required initially to prime any one unit served by the system is not usually considered, as the basic function of the system is to keep the pumps primed at all times ready to operate.

Why Relief Valves are Used

The power required by a vacuum pump increases with the vacuum. Should the vacuum pump be allowed to operate uncontrolled after the vent valves had closed it would continue to exhaust air from the piping and vacuum tank, if used, until it had established the maximum vacuum it could produce with a resulting increased load on the driver. To avoid this, most priming systems of an automatic or semi-automatic type using power driven vacuum pumps have a relief valve installed in the suction line of the vacuum pump. These are adjusted to admit air to the line if the vacuum exceeds a value above that needed for priming.

System for Air Charged Waters

Some waters, especially from wells, have considerable dissolved gas which is liberated when it is attempted to handle with a suction lift. In such installations an air separating tank (also called by some a priming tank and by others an air eliminator) should be used in the suction line. One type using a float operated vent valve to permit the withdrawal of the air or gas is shown in Fig. 7. Another arrangement, quite common, uses a float valve mounted on the side of the tank controlling directly the starting and stopping of the vacuum pump. With this arrangement there is danger of frequent repeated starting and stopping of the vacuum pump unless the air separating tank is relatively large and the capacity of the vacuum pump is only a little larger than the amount of air to be evacuated.

When sand is also present in the water the air separating tank can be

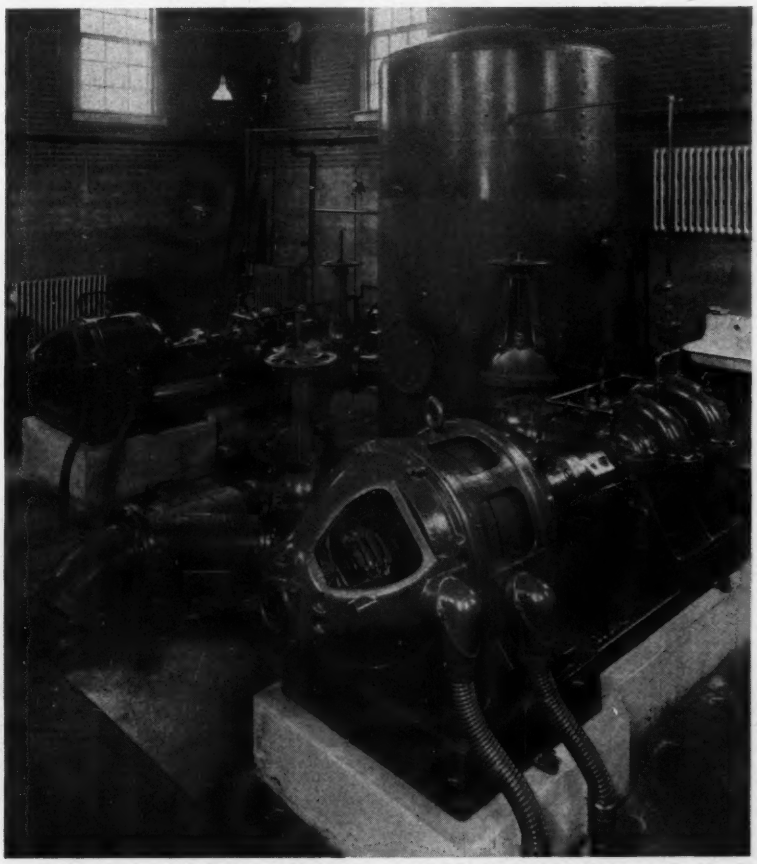


Fig. 8. Installation with automatic priming equipment utilizing combined air separating and sand chamber (DeLaval Steam Turbine Co.)

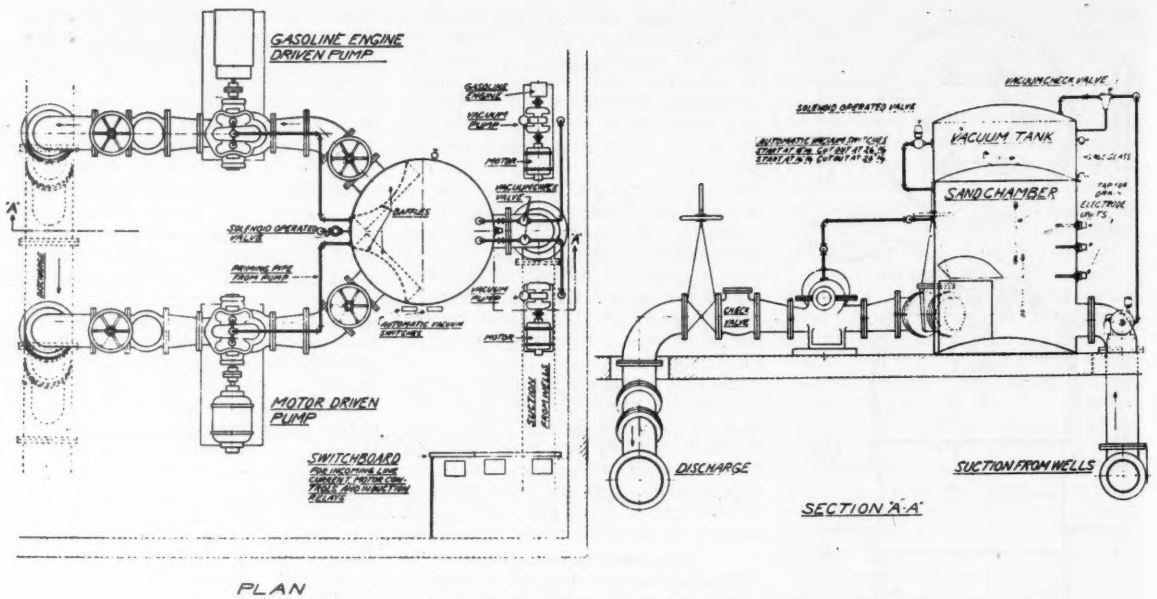


Fig. 9. Drawing of installation shown in Fig. 8 (DeLaval Steam Turbine Co.)

made so that it functions also as a sand trap as illustrated in Fig. 8 and 9.

System for Diesel Engine Driven Unit

With any centrifugal pump on a system in which there is danger of air leakage in the suction line, automatic priming is desirable. In case of a diesel engine driven unit, an automatic priming system using motor driven pumps would be desirable if a reliable source of electric power was available in the station. An auxiliary gasoline engine driven vacuum pump for emergency use might be desirable in case of electric power failure.

If a reliable source of electric power is not available, a direct connected wet vacuum pump with controls as used for similar motor driven automatically primed units is very satisfactory. Figure 10 shows such a unit.

System for Gasoline Engine Driven Unit

The choice of the priming device for a gasoline engine driven centrifugal pump would depend upon the size of the pump, upon the required frequency of priming and upon whether the unit is of a portable or a permanent type. Most portable gasoline engine driven pumps are for relatively low heads and small capacities such as units used for pumping out excavations and ditches. For this service self-priming pumps of various types are most satisfactory and are preferred to regular centrifugal pumps.

Some relatively small capacity high head portable gasoline engine driven pumps, notably units made for auxiliary fire pump service, utilize the vacuum existing in the intake manifold of a gasoline engine as a means of priming or keeping the pump primed. The rate at which the air can be drawn from the pump is relatively low, so that many such units use foot valves and are initially primed by filling the pump through a funnel or by means of a hand primer. If the vacuum in the manifold is utilized, provision has to be made so water will not be drawn over into the manifold.

For larger volume low head portable units a good provision for priming is a wet vacuum pump belted to the main shaft with a tight and loose pulley so that it can be stopped when the pump is primed as illustrated in Fig. 11.

For permanent installations, a separate wet vacuum pump driven by a small gasoline engine is generally preferred.

Priming of Steam Turbine Driven Units

With a steam turbine driven pump, the most logical means of priming is

(Continued on page 118)

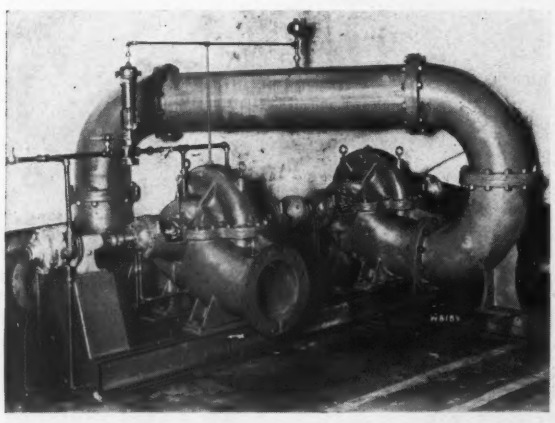


Fig. 10. Series pump with attached vacuum pump and controls to keep unit primed when in operation (Worthington Pump and Machinery Corp.)

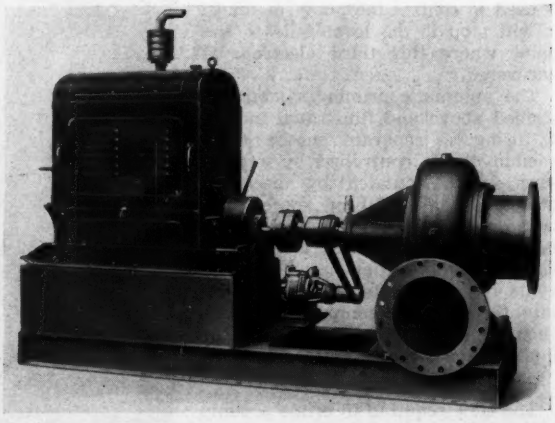


Fig. 11. Gasoline engine driven pump with belt driven priming pump using tight and loose pulley (Worthington Pump and Machinery Corp.)

BOLTING

For Pipe Flanges and Pressure Vessels*

By Sabin Crocker

Senior Engineer, Mechanical System Engineering Department, The Detroit Edison Company

CERTAIN BASIC practices in the usage of bolting for pipe flanges and pressure vessels have developed over some 20 yr, concurrently with the formulation on a national basis of dimensional standards, material specifications, and codes for piping. For reasons explained later in this article, each application of pipe-flange bolting usually has to possess one or more distinctive features which are needed to suit conditions peculiar to making pressure-tight flanged joints. Provision for these features has been incorporated in the various American Standards and ASTM specifications for bolting.

Prior to about 1925, steel flanges, fittings, and valve bodies were made to cast-iron patterns of the 125-lb or 250-lb steam classes or to the 800-lb cast-iron hydraulic standard with the diameter of bolting increased by about ⅛ in. in some cases. Headed carbon-steel bolts of ordinary commercial quality were used until steam temperatures went above 600 F, beyond which point the ordinary high-sulphur bolts were found unreliable and subject to brittle failure after prolonged exposure to temperature. Numerous cases were reported where bolt heads under stress in a flange snapped off when tapped lightly with a hammer. This led to the introduction of heat-treated alloy-steel bolt-studs made without heads and having threads and nuts on both ends.

Improved results with this type of bolting during the early 1920's warranted requiring heat-treated alloy-steel bolts or bolt-studs in the Tentative American Standard for Steel Pipe Flanges and Flanged Fittings from the time of its first issue in 1927. During World War II the shortage of alloy steels led to the substitution of heat-treated carbon-steel bolts as an emergency measure where service temperatures permitted. Applications of both types of bolt are illustrated in Fig. 1.

Some twenty years' experience with alloy-steel bolt-studs in high-pressure and/or high temperature service, and with carbon-steel headed bolts under less severe service conditions, is reflected in the requirements for flange bolting as set forth in national standards, specifications, and codes for piping. Pipe-flange bolts are usually ordered to the following ASTM specifications for the respective purposes shown, these applications being prescribed in ASA dimensional standards and codes.

Bolting Material Specifications

Where anything more than a non-descript "hardware store" article is wanted, ASTM specifications should be used in ordering bolting material, whether in the form of steel stock or as the completed product ready for installation. The term "bolting material" as used in ASTM specifications embraces steel stock in the form of rolled, forged, or cold-drawn bars, and completed items such as bolts, screws, studs, bolt-studs, and nuts and washers. The following specifications are in use:

Hot-rolled Carbon-steel Bars: (Screw Stock) Commercial-quality bolting material may be ordered as Grade 1120 of ASTM Tentative Specification A107-44T which corresponds to Grade 22 of Standard Specification A107-42. This is a low-carbon (0.18 to 0.23 per cent) open-hearth steel which may be used in the as-rolled condition, or after cold drawing. The medium-sulphur content (0.08 to 0.13 per cent) gives the material free-machining properties suited to threading. Sulphurized nut stock of both bessemer and open-hearth steel of commercial quality suitable for use with Grade 1120 bolts also may be ordered to A107. The chemical compositions and physical properties of carbon-steel bolting are given in Table I. Since A107 is a material specification only and does not contain requirements for the dimensions and threading of manufactured bolts and nuts, these features should be covered where needed by reference to the corresponding American Standards as mentioned later in this article.

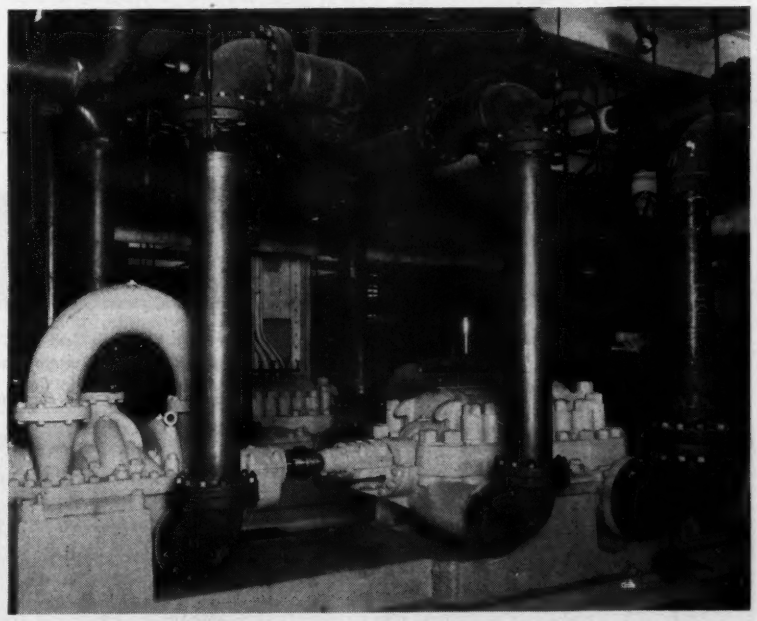


Fig. 1. Combination condensate and boiler feed pump before piping was covered Vertical pipes at left and center are 250-psi condensate lines with 250-lb American standard cast iron flanges and carbon steel machine bolts with square heads and hex nuts. Vertical pipe at right is a 1200-psi boiler feed line with 900-lb American standard steel flanges and alloy steel bolts with two hex nuts. Stud bolts for pump casing joints

*Reprinted from *Fasteners*, published by American Institute of Bolt, Nut and Rivet Manufacturers.

Table I. Chemical composition and physical properties of carbon and alloy steel bolting material

Description*	ASTM designation	Chemical composition, per cent					Physical properties, minimum				
		Carbon	Manganese	Phosphorous	Sulphur	Silicon	Tensile strength, psi	Yieldpoint, psi	Elongation in 2 in., %	Reduction area, %	Brinell hardness number
Bolts, carbon steel											
Hot rolled OH, grade 22	A107-42	0.15-0.25	0.60-0.90	0.06 max	0.075-0.15						
Hot rolled OH, grade 1120	A107-44T	0.18-0.23	0.60-0.90	0.045 max	0.08-0.13		66,000[a]	36,000[b]			
Heat treated OH or EF	A261-44T	0.55 max	1.00 max	0.04 max	0.05 max	0.15 min	100,000	75,000	16	45	
*Bolts, alloy steel***											
Class A—OH, EF, or C	A96-44	0.20-0.40[d]		0.045 max	0.05 max		95,000	70,000	20	50	190-250
" B—OH, EF, or C	A96-44	0.20-0.40		0.045 max	0.05 max		105,000	80,000	20	50	210-270
" C—OH, EF, or C	A96-44	0.20-0.40		0.045 max	0.05 max		125,000	105,000	16	50	260-320
Nuts, carbon and alloy steel											
Bessemer sulphurized stock	A107	0.08-0.16	0.50-1.00	0.12 max	0.075-0.15						
Open hearth sulphurized stock	A107	0.25 max	0.40-0.90	0.06 max	0.075-0.15						
Class 0—AB, OH, or EF	A194	0.25 max		0.10 max	0.15 max						120[c]
" 1—OH or EF	A194	0.15 min		0.05 max	0.05 max						120[c]
" 2—OH or EF	A194	0.40 min		0.05 max	0.05 max		Chro-	Molyb-			160[c]
" 2H—OH or EF	A194	0.40 min		0.05 max	0.05 max		mium	denum	Tungsten		248-352[c]
" 3—OH or EF	A194	0.35 max		0.05 max	0.05 max	0.50 max	4.0-6.0	0.40-0.60[e]	0.75-1.25[e]		248-352[c]
" 4—OH or EF	A194	0.40-0.50	0.50-0.95	0.04 max	0.05 max	0.15 min		0.20 min			248-352[c]

*Definition of symbols: AB = acid bessemer; OH = open hearth; EF = electric furnace; C = crucible.

**For properties of A193 bolting see ASTM specification. It is proposed to incorporate classes A, B, and C of A96 into A193 under the serial designations BA, BB, and BC.

Note a: Estimated average value instead of minimum.

b: Estimated value.

c: Values in the as finished condition. See A194 for values after stress relieving, and for corresponding Rockwell hardnesses.

d: Recommend values; also that the carbon ranges shall be 0.10 per cent.

e: Either molybdenum or tungsten may be used, if desired.

Heat-treated Carbon-steel Bolting: Heat-treated carbon-steel bolting material 2 in. and under in diameter may be ordered to ASTM Tentative Specification A261-44T. This is a medium carbon open-hearth or electric-furnace steel which has relatively high physical properties when heat treated. Headed bolts shall have semi-finished hexagonal heads or rough square heads in accordance with the regular or heavy series, as required, of ASA B18.2-1941. Unless otherwise specified the American Standard heavy hexagon series shall be used in accordance with usual piping practice. Bolts, studs, and bolt-studs shall be equipped with nuts conforming to ASTM A194. Threads and thread fit shall conform to the American Standard Screw Threads for High-strength Bolting, ASA B1.4 (see section on "Dimensional Standards for Threads" later in this article), in which sizes 1 in. and smaller in diameter have the Coarse-thread Series, and 1⅛ in. and larger the 8-pitch-thread Series.

Alloy-steel Bolting: At one time alloy-steel bolting material for pressure vessels, valves, flanges, and fittings for high-pressure and/or high-temperature service was bought to ASTM Specification A96 which covered three different strengths of material designated as Classes A, B, and C, see Table I. Nickel, chromium-nickel, chromium-vanadium, chromium-manganese, or any other types of alloy steel approved by the purchaser could be submitted under A96. For convenience these several types of steels were sometimes designated by their SAE or AISI composition numbers, some of the commonly used compositions being 2340, 3135, 3140, or 4140 depending on the expected operating temperatures. Physical properties conforming to any specified one of the three classes usually could be obtained from any one of the materials contemplated merely by adjusting the heat treatment to suit.

Later on the need for greater care in the selection of materials to suit some particular condition of high-temperature service led to the adoption by the ASTM of another specification, A193, which contains individual requirements for the chemical

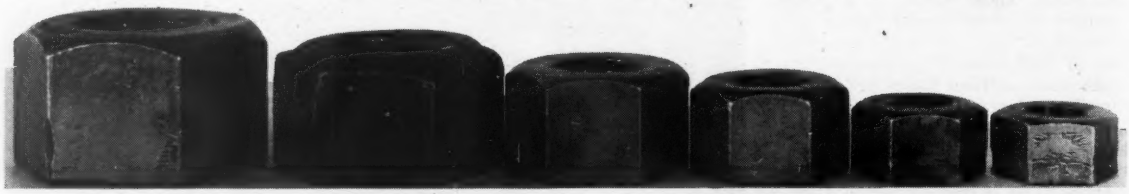


Fig. 2. Relative proportions of American standard nuts as given in Table II. Left pair, 1¼ in.; center pair, ⅞ in., right pair, ⅝ in. nominal bolt size. Heavy series nut is left one of each pair

Table II. Relative proportions of American standard heavy and regular series of hexagonal nuts.

Nominal bolt size, in.	Size of bolt hole, in.	Width across flats, in., bolt heads and nuts		Thickness of bolt head, in.		Thickness of nut, in.	
		Heavy	Regular	Heavy	Regular	Heavy	Regular
⅝	¾	1⅛	1*	½	11/32	11/32	11/32
⅞	1	1⅜	1⅝	19/32	⅜	11/32	¾
1¼	1⅜	2	1⅞	25/32	11/32	1 1/32	1⅛

*Width across flats for regular bolt head is 5/16 in.

composition and physical properties of each of several types of ferritic steel, and one austenitic steel (18-8). By the year 1945, however, the advantages of combining A96 and A193 into a single specification became apparent and it was decided to drop A96 and incorporate its three classes into A193 as additional grades designated as BA, BB, and BC. These grades have distinct physical properties and draw temperatures, but no chemical requirements beyond what existed in A96. Owing to the variety of compositions and physical properties offered in A193, space limitations preclude their reproduction here and it is suggested that those not already familiar with this specification refer to the book of ASTM Standards for 1944, Part I, Metals.

There are advantages in retaining the distinctive features of both A96 and A193 even when consolidated into one specification. Where service conditions permit, it may be convenient to specify what constitutes acceptable physical properties by mentioning Grade A, B or C without attempting to define the full chemistry. Under these circumstances the vendor is free to furnish what he has available without needless calling back and forth as would be the case if a specific composition were asked for which he did not have. On the other hand, where service conditions require a specific steel, this can be defined by using one of the numbered identification symbols of A193 and no substitution would be permitted without further consultation.

Requirements for dimensions and threading in both A96 and A193 are similar to those previously stated for heat-treated carbon-steel bolting.

Carbon- and Alloy-steel Nuts: Several classes of nuts made of carbon or alloy steels and suitable for use with the different varieties of bolts already mentioned are provided in ASTM Specification A194, see Table I. Classes 1, 2, and 2H are carbon steels, while Classes 3 and 4 are alloy steels. Other types of alloy steel with their appropriate heat treatments may be submitted under this specification if approved by purchaser. Where alloy nuts are used with bolts of the same chemical composition, it is advisable to have the nuts differ in hardness from the bolts in order to reduce the tendency for galling or seizing of the threads which would make it difficult to take a joint apart without destroying the bolts.

Class 0 nuts shall be made by the hot-forged or cold processes, or machined from hot-rolled or cold-drawn hexagonal bars. Classes 1, 2, 2H, 3 and 4 nuts shall be made by the hot-forged or cold processes, or machined from hot-forged or hot-rolled hexagonal bars. Classes 2H, 3 and 4 shall be heat-treated to meet the required physical properties. Heat-treated nuts shall be quenched and drawn at a temperature at least 100 F above the

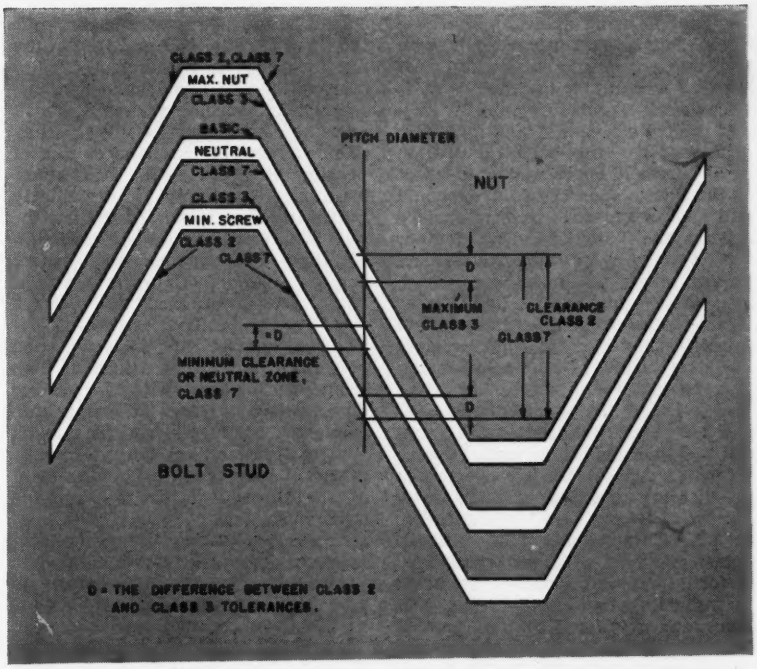


Fig. 3. Enlarged drawing showing relation of Classes 2, 3 and 7 fits, with neutral zone or clearance provided in class 7 fit

service temperature, but in no case less than 850 F for Classes 2H and 3, and not less than 1100 F for Class 4 nuts.

Class 0 nuts are for service under the least exacting conditions, Classes 3 and 4 for service under the most severe conditions, and Classes 1, 2 and 2H for conditions between these extremes. The steel shall be made by one or more of the following processes: open-hearth, electric-furnace, or bessemer. All nuts, except Class 0, made by the cold process shall be heated in the process of manufacture to a temperature of at least 1000 F before tapping. Nuts made by the hot process or machined from hot-forged or hot-rolled hexagonal bars need not be subjected to this stress relieving.

All classes of nuts except Class 0 shall be capable of meeting the following drift test: A conical mandrel, part of which has a diameter equal to the nominal nut size, shall be forced through the tapped hole to the nominal nut size, cold, without cracking the body of the nut. Class 0 nuts shall be capable of meeting the drift test as described above except that the mandrel shall have a maximum diameter equal to the pitch diameter of the thread rather than to the nominal nut size.

All nuts except Class 0 shall be capable of meeting the following stripping test: A nut shall be assembled on a piece of bolting material held in a tension testing machine so that a load is applied to the nut. The threads in the nut shall not strip when subjected to a stress equal to 130,000 psi for Class 1, and 150,000 psi for Classes 2, 2H, 3, and 4 figured from the mean diameter of the bolt; viz, the average of the root and pitch diameters.

All A194 nuts shall be semi-finished, hexagonal in shape, and in accordance with the dimensions of the Regular or Heavy Series, as required, of the American Standard for Wrench-Head Bolts and Nuts and Wrench Openings (ASA B18.2-1941). Unless otherwise specified the American Standard Heavy Series shall be used. Nuts used with alloy-steel bolts shall be threaded, unless otherwise specified in accordance with the American Standard Screw Threads for High-strength Bolting, ASA B1.4, in which sizes 1 in. and smaller in diameter have the Coarse-thread series, and 1⅛ in. and larger the 8-pitch Thread Series.

Dimensional Standards for Bolting

The usual practice for pipe-flange bolting requires bolt holes ⅛ in. larger in diameter than the bolts for several reasons, among which the following are of major importance: (1) Drilling pipe flanges and attaching them to the pipe is not a precision machining operation and reasonable leeway should be allowed for manufacturing tolerances. (2) Bolts should slip into place by hand without having to force them in even though a considerable amount of misalignment exists between the mating flanges. In starting to make up a joint the flanges are not going to fair up together too well at best and some clearance should exist in order to get the bolts entered. (3) There should be sufficient clearance within the bolt hole to prevent pinching or shearing the bolt if the flanges tend to dish while

the joint is being made up; likewise if the flanges assume an angle with respect to one another owing to a bending moment in the line.

The above mentioned need for having the bolt holes ⅛ in. larger in diameter than the bolts requires in turn that bolt heads and nuts be of ample size to span the bolt holes and still have a generous bearing surface against the flange face. A further reason for using heavy bolt heads and nuts is to provide the secure wrench grip needed for pulling bolts up as tightly as has to be done in making a pressure-tight joint. This requires adequate height of bolt head or nut as well as width across the flats. Hence, before the advent of the present American Standard for Wrenchhead Bolts and Nuts and Wrench Openings, ASA B18.2, it was common practice in the piping trade to order bolts and nuts to US Standard rather than to Manufacturer's Standard dimensions. This need was recognized in formulating an American standard by providing the Heavy Series bolt heads and nuts for use where greater bearing surface is necessary owing to clearance between the bolt and hole, or where more surface is considered essential for wrench grip.

Dimensional Standards for Threads

American Standard Screw Threads, ASA B1.1, are universally used for pipe flange bolts, subject to the choice of pitch and fit permitted within that standard which is traditional in the piping trade. For the commercial grade of carbon-steel bolting, the Coarse-thread Series with Class 2 Fit has proved satisfactory. For high-strength bolting of either heat-treated carbon- or alloy-steel, however, the 8-pitch-thread Series with a neutral zone for clearance in the thread fit as provided in ASA B1.4 has been found necessary.

Eight-pitch Thread Series: In sizes below the 1-in. nominal bolt size where the 8-pitch Series begins, the Coarse Thread series has 9 or more threads per inch and is satisfactory for the purpose. The choice of 8 threads per inch for sizes above 1 in. rather than the 4 to 7 threads of the Coarse-thread Series is dictated by the need for mechanical advantage in pulling up the joints tight enough for severe service conditions. Even with 8 threads per inch and lubrication it is usually necessary to use box wrenches with a pipe extension on the handle or to strike the handle repeatedly with a sledge. The 8-pitch Thread series also leaves somewhat more cross sectional area through the bolt at the root of the threads, thus affording greater strength through the weakest section of a highly stressed member.

Thread Fit: With high-strength bolting for piping and pressure vessels it has been found advisable to have a thread fit which possesses two important characteristics. First, there should be sufficient clearance between the thread on the bolt and that in the nut to permit full interchangeability of parts and to allow hand-tight assembly, but at the same time the fit must be close enough to prevent any undue feeling of looseness or loss of bearing strength. With bolt studs, hand tight assembly is particularly important as a means of getting the nuts evenly entered on both ends until they bear against the flanges enough to hold their proper positions while being wrenched up. Second, the fit must permit disassembling the parts without seizure after a period of service under severe load at high temperature. A fit with this degree of clearance further facilitates both tightening and removing the nuts in that it affords space for retaining a lubricant which would be forced out of the threads if the fit were too tight.

The general recognition of the foregoing basic characteristics needed in threads for high-strength bolting in pipe flanges and pressure vessels led to the formulation of the American War Standard for Straight Screw Threads for High-temperature Bolting, ASA B1.4-1942. This standard fulfilled its purpose so well that it has been proposed to take it over bodily, except for a change in title, as the regular American Standard Screw Threads for High-strength Bolting, ASA B1.4. In these standards the full Class 2 tolerance was chosen for the nuts for reasons of economical manufacture, both as affected by the wear limit of tools and, in the case of heat-treated nuts, to permit tapping before heat treating. The bolt thread is cut to a Class 3 tolerance after providing a neutral zone for clearance inside the basic screw dimension, the tolerance being taken exclusively from the bolt stock so as to leave more clearance rather than producing interference with the nut thread.

The foregoing combination, which has been found to behave better with high-strength bolt studs than the regular Class 2 Fit, is designated as Class 7 Fit in ASA B1.4. General requirements for gaging screw threads with descriptions of the several classes of fits will be found in American Standard Screw Thread Gages and Gaging, ASA B1.2-1941. The relation of Class 7 Fit of ASA B1.4 to Class 2 and Class 3 Fits of ASA B1.2 is illustrated in Fig. 3 from which the following conditions are evident:

Condition 1.—In the regular Class 2 and 3 Fits both the "minimum" nut and the "maximum" screw can approach from opposite sides the line marked "basic." With a small error in the thread angle or in the lead of the screw or nut, or with a slight roughness in machining the threads, actual interference may result or, at best, the available clearance may be too small for free assembly by hand.

Condition 2.—With the Class 7 Fit, a "neutral" zone is provided between the mating parts by having the "maximum" screw on the bolt stud set below the "basic" line by an amount corresponding to the difference between Class 2 and Class 3 tolerances. Hence the "minimum" screw of the Class 7 Fit is the Class 2 tolerance below "basic," or the Class 3 tolerance below the line marked "Class 7" at the lower edge of the "neutral" zone.

Condition 3.—It is evident from Fig. 3 and Conditions 1 and 2 that the maximum degree of looseness permitted in the Class 7 Fit is identical with the Class 2 Fit, whereas the "neutral" zone prevents interference and insures free assembly by hand.

In the absence of special gages for the purpose, the neutral zone or clearance desired in the Class 7 Fit can be obtained by gaging the bolt threads with the regular Class 2 Fit "not-go" gage, and setting up the adjustment somewhat on the Class 2 Fit "go" gage so that the product comes to the desired dimension as determined by spot checks with pitch micrometers. Should the Class 7 Fit result in more looseness in the threads than is desired for any specific purpose, the author would suggest tapping the nuts to Class 3 rather than to Class 2 tolerances. As Class 2 taps wear a bit and do not bite quite so deeply as when new, the nut threads tend to come within Class 3 tolerances anyway.

Length of Bolt and Thread

Where bolt-studs having two nuts are used, two alternatives for threading exist; viz, on the ends only or full length.

With headed bolts it is customary to thread only as much of the bolt as needed to accommodate variations in flange and facing thicknesses. Owing to the fact that bolts of any given diameter are not always used with flanges of the same thickness or facing dimensions, consideration should be given to specifying both the overall length of bolt and the length of thread required, unless the bolt is threaded full length.

Standard Lengths for Bolts and Threads: In the American Standards for cast-iron flanges and fittings where headed bolts are used and the flange facings are of one general type, the required length of bolt is tabulated in the standard. With steel flanges and fittings, where bolt-studs are commonly used and several types of flange facings are offered, a considerable choice of lengths is required in any given bolt diameter to suit different conditions of flange thickness. Consequently most piping designers have to draw up their own schedules of bolt-stud dimensions to suit individual practice. In preparing such schedules consideration should be given to consolidating approximately equal lengths of the same diameter bolting so as to reduce the

(Continued on page 120)

New Developments in Power Generation Discussed at

Midwest Power Conference

Potentialities of the gas turbine and atomic energy . . . Problems in modern power plant design . . . Civic responsibilities of engineers . . . Electrical developments . . . Developments in space heating and air conditioning . . . Hydro plants . . . Insulation problems . . . Diesel power . . . Fuels . . . Radar . . . Forecasting business trends

THE MIDWEST POWER CONFERENCE, sponsored by the Illinois Institute of Technology with the co-operation of the ASME, AIEE, and various midwestern universities, was held on April 3, 4 and 5 at the Palmer House in Chicago. This year's meeting was the first since 1944, because travel restrictions made it necessary to cancel the meeting in 1945.

This conference provides an opportunity for all persons interested in the production, transmission, or consumption of power to meet and discuss their problems, free from the restrictions of required membership in technical or professional organizations. The academic sponsorship furthermore permits the freest possible discussion of technical, economic, and social aspects of engineering work.

The conference this year followed the general pattern set in previous years; it comprised a number of sessions devoted to more or less specialized subjects as well as several general sessions of interest to everybody. Each day there was a luncheon meeting and on Thursday, an "All Engineers" dinner was the high point of the conference. At this dinner meeting Rear Admiral John L. Manning, Chief of the Bureau of Yards and Docks, was to have been the principal speaker. In his absence, Admiral Henry A. Taylor, presented his paper on the value of engineering as a national safeguard. Lt. General Raymond A. Wheeler, Chief of Engineers, U. S. Army, also addressed the dinner meeting, his topic being "The Corps of Engineers in War and Peace."

On the whole the technical papers presented at the conference were of an educational nature rather than highly specialized. The purpose of most of the papers was to acquaint engineers in one branch of the field with development in allied branches. Thus, the electrical man could learn something of what is going on in the field of steam generation by attending the sessions on fuels and boiler practice; conversely, the steam man could profit by attending some of the electrical meetings. Some of the more modern developments received special emphasis. Gas turbines, for example were discussed at two sessions. Atomic energy was discussed first at the opening general session by Philip Swain, Editor of Power, and at another session by R. R. Wisner of Stone & Webster. Mr. Wisner described many interesting details of the electromagnetic separation process at Oak Ridge, Tenn.

Both central station and industrial power plant practice received detailed attention and there were two sessions on hydroelectric power. The first of these dealt with two broad national aspects of hydroelectric development, the St. Lawrence River projects and hydroelectric power development in the Missouri basin.

Electrical developments were covered in two sessions, one of which included papers on Silicones and rotating regulators, and the other was devoted more specifically to transmission line problems and cable insulation. Radar was the subject of a demonstration and lecture at the luncheon on Friday.

Other subjects discussed at the conference were developments in air conditioning, feedwater treatment, space heating, Diesel power, fuels and industrial load supply. At the general session on Friday, a number of speakers discussed the general subject, "Your nation's future, an engineering problem."

So much for the general plan of the conference. Attention will now be directed to a more detailed consideration of the more important sessions and technical papers.

Growing Use of Electric Power

Among the several papers presented at the opening session, the most interesting perhaps from a practical standpoint was one discussing the future requirements and trends in the use of electric power, presented by Howard P. Seelye of the Detroit Edison Co. Mr. Seelye's views of future load growth while optimistic were quite moderate and based on a sound knowledge of the various factors involved. For example, while he expected an increase in the residential lighting load he felt that the actual increase in load would be somewhat offset by the higher efficiency of the fluorescent lamp. Increase in resi-

Fig. 1. View taken at the general session

Stimulating Quotes

"In the past, we engineers have been all too content to work on our technical developments, leaving the use to which these technical developments are to be put to the laity who cannot reasonably be expected to understand what our technological age can accomplish.

"Similarly, scientists the world over have been accustomed to search and research for new facts, assuming no responsibility for the social results of their efforts. The atomic bomb has brought home to scientists the fact that they must accept the social responsibilities for their acts."

D. C. Prince.

"The engineer must actively interest himself in government and politics, realizing that his contributions to society may be lost without stable government. He must work for good government, for obedience to law, and must apply clear thinking and courageous action to public questions.

"In these days when unrest is too prevalent to be ignored, the greatest need of this or any democratic government is men and women in political o f f i c e who think logically, conclude honestly, and act courageously."

A. A. Potter.

"When purchased on a Btu basis, coal has an average advantage of about 4 to 1 in price over Diesel fuel, and an advantage of almost 2 to 1 in most locations over fuel oil. This spread in price means that a gas turbine burning solid fuel, with a thermal efficiency somewhere in the 20 per cent range, will be considerably m o r e economical in operating costs than the Diesel engine, with a 34 per cent thermal efficiency, when the latter must burn oil which costs between 5 and 6 cents per gallon."

John I. Yellott.

"Radar has immediate significance in the industrial world. No pause will mark the transition of radar from war to peace. Directly, in air and sea navigation, radar in its present form is eminently practical; indirectly, it has radically influenced the field of radio television, and communications in general. Its effect on the entire field of electronics is already very great."

J. A. Hutcheson.

Fig. 2. Ralph E. Turner, Editor, POWER PLANT ENGINEERING, E. R. Ambrose, Gas and Electric Service Corporation, and E. M. Mittendorf, Kramer and Mittendorf

dential load by the increased use of electric cooking was also to be expected, but here again, he pointed out, the increase was bound to be gradual because of competition from other fuels.

With respect to the industrial load, Mr. Seelye did not expect any rapid increase in load because industry has been electrified to a high degree insofar as the use of motors is concerned, and in the heating field strong competition from other fuels will have its effect. The trend toward shorter working hours also will tend to counteract any rapid increase in industrial load growth.

Power Plant Design

At the joint luncheon with the ASME, Wednesday noon, Alf. Kolflat of Sargent & Lundy, spoke on "Problems in Power Plant Design." Curiously enough, in his opinion the majority of the tough problems that power men still have to solve center around coal handling, from car to stoker or pulverizer. Frozen coal imposes a difficult problem and while various methods of unloading frozen coal cars have been developed, there is room for considerable improvement. Among the various systems in use for unloading frozen coal, Mr. Kolflat mentioned the rotary car dumper, use of steam jets, compressed air nozzles, a variety of screw-type devices for loosening coal, vibrators and finally, radiant heat. (See POWER PLANT ENGINEERING, March, 1946, page 69), Mr. Kolflat proposed that electrical engineers try to design a chamber using high frequency heating for quickly thawing out a mass of frozen coal.

He said the reduction of the boiler safety factor during the war from 5 to 4 was a good idea since the factor of 4 today is probably safer than 5 was 20 yrs ago, because we know that our design figures are more exact now, and the need for a high factor of safety to cover up possible design errors is not as great.

Power plant construction costs are estimated to be 20 to 30 per cent greater than they were before the war, but increased pressures will be used to lower operating costs by increasing plant efficiency. The increase in efficiency by advancing pressure from 400 to 800 is the same as from 1600 to 3200 psi, so the law of diminishing returns will limit the pressures to be used.

Processing of Water

Water conditioning in plants using high percentages of chemically treated make-up was discussed by Leo F. Collins, Detroit Edison Co., who stated that the actual processing of water for a given plant usually involves a lot of engineering and a modest amount of chemistry. With that idea in mind, he talked the language of the engineer rather than the chemist.

If a water treatment system is to prove satisfactory it must be designed not only to fit the technological requirements of the plant but also the talent available for its operation. Overzealous attempts to hold first costs down to a minimum exaggerate the difficulties introduced by failure to consider these factors.

Some of the expedients used to hold down first costs are listed by Mr. Collins as:

1. Preliminary studies are omitted or superficially conducted.
2. Inadequate treating capacity is provided.
3. Too few operating guides are supplied.
4. Treating equipment is stuffed into the plant.

Space Heating

In the panel on space heating, E. M. Mittendorf presented T. Napier Adlam's paper on "Radiant Heating." He pointed out the well-known but interesting fact that the Romans used radiant heating two thousand years ago.

Referring to a radiant heat installation in a cathedral in England, he said that when the air temperature at a point 4 ft above the floor was 60 F, the temperature taken at a point over 90 ft above was 58½ F, just 1½ degrees lower. "Without doubt no other known method of heating could create these ideal conditions in such a high building."

Industrial applications of the heat pump were discussed in a paper by

Philip Sporn, E. R. Ambrose, and Theodore Baumeister, read by Mr. Ambrose. Actually the heat pump is a compression type refrigeration system, consisting of an evaporator, condenser, compressor and expansion valve. When operated as a refrigerating system in the conventional way it pumps heat from an enclosed space and rejects it at a higher temperature level. Since the refrigerating cycle is reversible, the system can be used to pump low temperature heat to a higher temperature level. To use the system for heating, the air to be heated can be blown over the condenser, while the evaporator absorbs heat from the "cold" outside air. It is not universally applicable, but does have advantages for special applications where a low cost fuel is available.

New Uses for Silicones

Silicones, as explained by G. L. Moses, Westinghouse Electric Corp., in his paper entitled "Silicones Offer New Approach to Insulation Problems," are a new class of high polymeric materials, derived from sand, brine, coal and oil as ultimate source materials. Their synthesis involves a number of steps and a considerable amount of industrial and chemical technology.

Silicone polymers take several physical forms, the first group to reach commercial production being liquid silicones. These are characterized by properties of low viscosity, low freezing point, unusual inertness and stability to heat. They are being used as gage liquids, damping fluids and in various hydraulic applications.

A transluscent silicone grease which looks like vaseline, but does not melt on exposure to heat, is used as a lubricant for ignition cables to reduce corona cutting of the insulation and to permit easy wiring. Other greases are being used for lubricating ball and roller bearings, and one type can be used at temperatures as low as 60 F and has high temperature stability at least equal to the best available organic greases.

Silicone rubber-like compounds, called "Silastics," have been used for compression molding and as pastes for various coating purposes.

Fig. 4. A. D. Singh and John I. Yellott

Silicone resins are available in the insulating varnish type, comparable to organic oleo-resinous varnishes, and in a form corresponding to the organic thermosetting resins used to make rigid laminated insulating parts.

Business Forecasting

That future business estimates can be made with reasonable accuracy was indicated at the joint luncheon with the AIEE on Thursday, when D. C. Prince, General Electric Co., spoke on the subject "Promotional Engineering." He showed charts which he had prepared in 1941 predicting future trends in national income. He picked 1946 as the post war year and estimated a gross national product for this year of 110 billion dollars, at 1940 price levels. With allowance for increased price and wage level brought about by the war-induced inflation, he said that this 110 billion may yet represent very closely the 1946 gross national product. He estimated the correction multiplier to be about 1.4, which brings the gross national product to 154 billion.

Gas Turbines

The opening paper in the discussion on gas turbines was presented by L. N. Rowley and B. G. A. Skrotzki, editorial staff of Power, in which it was stated that "Viewing the gas turbine as a prime mover, it seems fair to say that it is established as thermodynamically practical and that the mechanical problems associated with high efficiency, high temperature design can probably be solved on a commercial basis. If methods of burning solid fuels directly in the gas circuit can be developed, the potential field of application will be enormously widened."

Valuable linear relations for gas turbines were presented by Dr. John T. Rettaliata, Illinois Institute of Technology. These relationships simplify greatly the involved calculations associated with gas turbine cycles. To cite just one of the many relations presented, Dr. Rettaliata states, "For a given pressure ratio the isentropic change in enthalpy occurring during expansion in a turbine is a linear function of turbine inlet temperature for fixed values of isentropic exponent—and gas constant."

J. R. Carlson, Westinghouse Electric Corp., summarized the future of the gas turbine as follows:

"Even though we have accepted the jet engine for fighter aircraft as an accomplished fact, it is only making a glamorous beginning. The future of the gas turbine in the aircraft industry using both the jet engine and gas turbine propellor drive is indeed bright. Geared gas turbine propellor drives of 5000, 7500 or even 10,000 hp

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Fig. 3. Speakers at the general session. Left to right: Samuel R. Harrell, L. J. Fletcher, F. A. Faville, A. A. Potter, Roy V. Wright, and Melvin J. Evans

ATOMICS

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

Electromagnetic Processes of the Atomic Bomb Project

By R. R. Wisner

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AS DESCRIBED in other articles that have appeared in this section on "Atomics," the two principal methods used in the separation of U-235 from natural uranium in the atomic bomb project, were the electromagnetic method and the gaseous diffusion method. Both of these methods have been described in these other articles. Of the two, the electromagnetic method, fundamentally, was the simplest and, as it developed, despite the almost insuperable difficulties of designing and constructing the equipment needed for its operation, it was the first method whereby suitable quantities of the usable product were produced. For nearly a year the electromagnetic plant was the only plant in production of U-235. Because this method of separation was so important and because its development involved engineering problems of such tremendous magnitude, the details of the construction and operation of the actual plant as disclosed here by Mr. Wisner will be found of unusual interest. As the author explains his discussion is confined to the electromagnetic process designed, constructed and placed in preliminary operation by Stone & Webster Engineering Corporation. The discussion presented here was given as a paper at the Midwest Power Conference in Chicago on April 5. The engineering aspects of the design and operation of this plant will be of particular interest to engineers. Before this plant was built, the largest magnet in existence was the 184-in. cyclotron magnet at Berkeley. In the construction of the Oak Ridge plant, they had to produce electromagnets nearly one hundred times as large, and they did.

THIS article is confined to that portion of the atomic bomb program designed, constructed and placed in preliminary operation by Stone & Webster Engineering Corporation, namely, the Electromagnetic Process for the separation of the U-235 isotope of uranium and the general utilities and housing development for the town of Oak Ridge, Tennessee.

The electromagnetic process is basically the mass spectrograph method, and in principle is rather simple. A suitable compound of uranium is first vaporized, then it is ionized or electrified by passing through an electric arc. Then the electrified atoms are given a forward acceleration by passing through electric fields having an increase in potential. The electrified and accelerated atoms are moving at high speed in a strong magnetic field which causes them to travel in a circular path, the diameter of the path is a function of the mass of the atoms, thus the lighter U-235 atom travels on a smaller diameter than the heavier U-238 atom. At the proper point in these circles separate containers are placed to receive the U-235 and U-238 atoms respectively. In the natural state U-235 occurs with U-238 in the ratio of one part to 140 parts. Therefore, to make the desired separation on a commercial scale required the construction of a mammoth industrial plant.

Some idea of the magnitude of this development may be gained from the statement that the work supervised or done directly by Stone & Webster's own forces has a value of $427,000,000, including the purchase of equipment for the plant and construction of most of the City of Oak Ridge, which had a peak population of about 75,000, also that the manufacturing plant consists of about 175 buildings having a

total working floor area of about 4,500,000 sq ft. Plant design and construction, and to some extent even the housing, was accomplished under the handicaps of a remarkably successful secrecy control.

This control made it necessary to set up an independent engineering organization with representation at several locations to cover direct contact with the physicists, chemists, operators, and construction at the job site, with only a selected few having knowledge of what was to be accomplished. Upon these few was placed the responsibility of coordinating the parceled-out portions of the work. Many thousands of drawings had to be provided so that the workmen in the field and in the factories could produce the component parts and subassemblies without gaining a clue as to the end product. In spite of security restrictions and shortages of material and manpower, and because of the marvelous patriotic cooperation of practically every conceivable type of personnel and industry, there was completed within a three year period, a program of development and production, that in peacetime, would easily require 10 to 15 years.

The urgency was so great that small scale laboratory developments were expanded directly into a gigantic production unit which had to be operable by personnel secured from all walks of life and with no previous training. Actually the electromagnetic plant was the first unit to produce suitable quantities of the usable product, and for nearly a year was the only plant in production.

It is not possible for me to present a complete outline of all the interesting phases of this project and its early operation but I will cover a few of what to me are the most outstanding or unusual features and trust that such treatment will prove interesting to you.

In order to maintain some semblance of coherence for this discussion, it is my plan to follow the three main groups just mentioned with a brief description of some of the components and to add some interesting points by outlining a few of our operating and design difficulties. Considering the many thousands of items that functioned satisfactorily our troubles were few indeed.

Electric Power Supply

First, I will briefly cover the electric power supply system.

Due to security reasons all that can be said at this time of the loads in the electromagnetic process buildings is that they were of such a nature that individual three-phase 154- kv transformers were required for each unit of the plant. The largest single units of load were 8400 hp, 13.8 kv, 3-phase synchronous motors which were started across the line.

Due to the tremendous pressure for speed of accomplishment and the wartime shortages of critical materials and equipment, the electrical power supply system was made as simple and at the same time as reliable as possible. The project consisted of two major parts, namely the original project known as the Y-12 Area and the expanded program known as the Y-12 Extension Area. The Y-12 Area was supplied over two 154-kv wood pole transmission lines of the TVA system to a switching station and substation having a single 154-kv bus using wood pole and wood frame substation structures. From this substation power was supplied to the Townsite through suitable transformers, and to the individual process buildings over 154-kv wood pole lines connected directly to suitable transformers, the secondaries of which were connected to single bus metalclad switchgear and unit-substations. Carrier pilot wire and distance type relay protection were also provided. For the Y-12 Extension area a second 154-kv single bus wood pole structure switching station was constructed, which was supplied by a third 154-kv TVA line and a wood pole tie line to the original substation. This switching station supplied the additional process buildings in a manner similar to that described above for the original area. Disconnecting switches between pairs of lines were provided to facilitate oil circuit breaker maintenance. All this was expected to give and virtually did give 100 per cent continuity of service in a very high annual load factor basis. Certainly it could not have been simpler and time proved such simplicity to be the essence of reliability.

The wood pole and frame construction with grounded static wires proved to be impervious to lightning. I have a keen recollection of watching, with considerable apprehension, a terrific lightning storm one summer afternoon right in our midst and this power supply system rode the storm without a flicker.

ATOMICS

The Magnetic System

It is now no secret that we constructed some big electromagnets with the emphasis on **big.** These were huge structures, 250 ft long which contain thousands of tons of high permeability steel each. Prior to their construction the largest magnet in existence was undoubtedly that of the 184 in. cyclotron at Berkeley. We were required to design and build electromagnets nearly one hundred times as large.

Another interesting feature in the magnet construction was the use of silver instead of copper for the electrical conductor of the windings and buses. We "borrowed" from the United States Treasury about 14,000 tons of silver having a value of over $400,000,000. This value is not included in the figure of $427,000,000, which I have previously stated as the value of work done by Stone & Webster. This silver was delivered in ingots to copper rolling mills, where it was rolled into strips. These were later welded together with silver solder into conductors of the required length. Every splice was stamped with code markings. The entire operation on the silver was under continuous surveillance of army officers and it is interesting to note that the work was so well controlled that every ounce of silver from the Treasury vaults has been accounted for.

I am not privileged at this time to divulge the details of the magnet construction, that one item was a major electrical engineering and construction project. Compared to this project, the cyclotron magnet is simple. The insulation and operation of a small magnet with a single series circuit is simple compared with these larger units with many parallel circuits. It was difficult to develop the

Fig. 1. A side view of one of the giant production plants at Clinton Engineer Works at Oak Ridge, Tenn.

proper sense of proportion on this portion of the project and much of it was learned the hard way. Usually the problem of insulating for operation at 300 to 1,000 v d-c to ground would present no serious problem to the electrical engineer. You would probably believe that a good air dried fibrous insulating board, soaked in oil would suffice, but in this case it was not so simple because there are about 40 tons of such insulation between the conductors and ground in one magnet. Two simultaneous grounds on the electric circuit of one of these magnets would be a catastrophe.

Moisture, magnetic particles, and rust were our worst enemies. It should be no surprise to you that there is considerable heat generated in these giant electromagnet coils, and transformer oil was used as the cooling medium, through heat exchangers. All fibrous insulation had to be thoroughly dried, the oil piping system had to be made and maintained scrupulously clean and dry, and the installation had to be made with the greatest of care. The dielectric strength of this oil is kept at a value higher than that in the 154-kv transformers. Our early experience with the first magnet was exceedingly hectic, due primarily to a lack of realization of the extreme importance of removing and keeping out all traces of moisture and foreign matter in the coils and the oil cooling system, and as a consequence the ground resistance went through some fantastic capers. During this preliminary period we had a healthy crop of theories advanced in an attempt to explain some of the phenomena experienced. However by lots of effort and numerous consultations this situation was cleared up rather quickly and completely.

Motor generator sets are used for excitation and each one has a definite duty of giving 100 per cent service continuity on 100 per cent annual load factor basis, no stand-by or reserves having been provided. After clearing up a few bugs, the performance given by these devices was nothing short of miraculous.

Those who are familiar with the mass spectrograph should know that the steadiness of the magnetic field is of utmost importance. A regulating device for the motor generator sets and magnets was developed that held the magnet excitation to a variation of less than one part in five thousand. This was not accomplished in one fell swoop, considerable debugging was required. The problem of mounting turned out to be a real problem; tennis balls, inertia pads, spring suspensions, and soundproof covers were tried and the successful solution was found in a remarkably short time.

You should be familiar with the fact that the d-c field of a generator or a large d-c solenoid has quite a kick when the current is interrupted. In this case we really had a problem in handling the switching and the short and open circuit protections of the magnet and its coils. Among other things, we installed ingenious protective devices across the individual coils.

The physicists did a remarkable job in working out the characteristics of the magnets since the actual results obtained were above expectations and all they had to work with were theory and a small model improvised from materials at hand and which, as I remember, could only be excited for about 30 seconds to stay within a safe temperature rise.

The mass spectrograph has an evacuated operating chamber within the air gap of the magnet. For this project we called this item "a bin." In the first magnets there were two of these bins placed back to back in each air gap. We soon discovered that for no clearly defined reason the bins moved apart, so again all sorts of theories and explanations were advanced, electrical, magnetic, mechanical and otherwise. After some deliberation and frequent consultations, it was decided to pull the bins back in place and energize the magnet with all other questionable items removed to see what would happen. When everything was set one evening, two or our magnet experts and I climbed on top of the magnet after it was re-energized, and some of the bins moved right under us. We surely had a most weird, vivid and practical demonstration of "the theory of least work" in a magnetic circuit. We spent the rest of that night developing the solution which turned out very simple to accomplish, merely involving strapping the two bins together. Of course, it took some clever calculations to determine the size of the straps.

Effect of Strong Magnetic Fields

One of the problems in connection with the magnet design was that of carrying on operations in the strong magnetic field within and surrounding each of the magnets. This magnetic force was so strong that when a twenty-penny nail was held in the hand a strong effort was necessary to prevent the wrist from being twisted. The pull on the nails in the heels of a pair of shoes is strong enough to make walking difficult at certain points. An ordinary wrench or pair of pliers would either be wrested from a workman's hand, or if he held onto it, it would be drawn against the magnet face and his knuckles skinned or even badly bashed. To counteract this, all movable equipment and structures that were used within the range of the magnetic field had to be built of nonferrous metals or of nonmagnetic steels. This made it impossible to use standard designs for any of this equipment. Large quantities of stainless and other nonmagnetic steels had to be procured at a time when they were badly needed for other parts of the War Program. Workmen in many shops and on the job had to be trained in welding of these materials, in heat treating and hardening them and in working them in many other ways. A complete set of small tools of beryllium copper had to be designed and produced.

High Vacuum Required

I have previously mentioned the "bin" or the evacuated operating unit within the air gap. The matter of vacuum was one of our interesting problems. The beams of electrified uranium atoms, which are curved by the action of the strong magnetic field must operate in an extremely high vacuum. As much air and gas as possible must be exhausted from these "bins," otherwise the electrified uranium atoms would collide with atoms of oxygen, nitrogen and other gaseous elements and in doing so they might lose their electric charges and would no longer be under the proper con-

Fig. 2. A general view of one of the production areas at Oak Ridge at Oak Ridge, Tenn.

trol for the desired collections in the receiving pockets. In steam turbine practice an inch of mercury, or 25 mm, is considered a high vacuum, but even such a vacuum would contain enough gaseous contamination to prevent any separation of the U-235 isotope. The vacuum stipulated for proper separation is of the order of 25 million times less than that considered standard in power plant practice. To produce such a vacuum, enormous pumps of the diffusion type had to be designed and built, and had to work in series with standard mechanical constant displacement pumps similar to those made by the Kinney Pump Co. The fabrication and installation of the equipment and piping for the vacuum system including the gasketed joints had to be done with the utmost care and skill. A tremendous amount of field welding had to be done and it is a fine commentary on the skill and integrity of our workmen to be able to state that we had remarkable success with the vacuum system. The testing for and location of leaks was a science in itself and much of this phase was done by the physicists. Near the end of the construction program there had been developed an ingenious leak detector that reduced tremendously the task of keeping the vacuum system tight.

Power Supply and Control

The operating unit and its power supply and control really takes us into the realm of advanced science and could be the source of most interesting stories of scientific accomplishment, but also therein lie our greatest secrets. This was the part that received the greatest contribution from the electronic experts. Again referring to previously published comparisons of this process to mass spectrograph, you should know that there are associated therewith sources of high voltage direct current supply that must meet exacting requirements in adjustment and in constancy of potential, namely, 1 part in 2500 to 5000. To provide the required power supply and its controls, many thousands of standard items (particularly electronic) were used in very ingenious circuit arrangements. Really a radio Ham's paradise. The problem of "debugging" called for a goodly share of attention and the speed and ingenuity with which knotty problems were conquered was miraculous. Many of you should be familiar with the flash-back troubles with Mercury arc rectifiers, mere child's play compared with the early problems on this phase of the project.

As in a radio station, cooling with water having a very high resistance value is required to give adequate insulation to ground on some of the high voltage circuits. For this project there was developed a high resistance water cooling system using continuously deaerated deionized water which allowed the use of common materials for the water piping circuits.

Many hundreds of thousands of feet of special cable were designed and placed in successful operation. The power sources to the high voltage supply units and accessories, such as Kinney and diffusion pumps, are taken from unit substations by radial feeders and mains.

I feel justified in stating that throughout this project we did an exemplary job of playing ball with the W.P.B. in the use of critical materials, one outstanding exception being on the grounding and shielding of the high voltage process portion of the electrical system. We simply could not skimp or substitute on the use of copper for these items.

This electromagnetic project was expanded directly from small scale laboratory developments into a gigantic production unit without benefit of pilot plant proving. In a sense it is an overgrown laboratory with all the exacting requirements for fine tolerances and ultra close control and adjustment. The operating and power supply thereto is unquestionably susceptible to considerable simplification and increased output; something similar to our first radio sets, which had a lot of meters and dials to facilitate adjustments.

So much for the operating unit and its power supply.

Although I am credited with being an electrical engineer, it was my privilege to be intimately tied in with other branches of engineering, such as mechanical and chemical and to be associated with outstanding members of the Engineering profession, and with scientists galore, in fact the best in the world. We were all in deadly earnest to make this thing work within the shortest possible time. Particularly during early construction and preliminary operation and testing, shifts were twenty-four hours a day. Many sessions of twenty-four, thirty-six, forty-eight and sixty hours' duration without sleep were held to clear up some troublesome situations. No accomplishment such as the Atomic Bomb could have been created in so short a time by regimented or brow-beaten personnel.

Our problems were not all electrical and mechanical but spread pretty well throughout all phases of engineering, physics and chemistry.

Chemical Problems

Speaking of chemistry, I will now give you a brief outline of the important part played by chemistry.

During the operating period, not all of the feed material is separated into its two component isotopes. A considerable proportion of it goes astray and has to be recovered from the interior walls of the containing vessel and from parts of the operating equipment. Practically all uranium compounds have a high capacity for absorbing water. The metal also has a tendency to revert to the oxide. Another complication was introduced by the fact that the energy of the ionized particles is so great that those which go astray and which impact on various parts of the apparatus, combine either chemically or physically with the metals forming those parts. The result is that a large operating area must be provided for washing and cleaning operations, in which all parts of the operating apparatus are cleaned with steam or acid. The product is an acid solution of uranium compounds containing large quantities of iron, nickel, copper and a number of other metallic elements. All of these must be separated from the uranium before it can be recycled in the process, or before it can be passed on to the final concentration stage. Also, the uranium must be converted to the chemical compound, which has been found most suitable for feed to the process. This compound must be of the highest degree of purity, completely dry, and very finely pulverized. One of the important tasks was to design an enormous chemical plant in which these reclaiming operations are conducted. Almost all of this equipment had to be designed from the ground up, with only test tube or small pilot plant experiments as a guide. Here again the magnification

(Continued on page 118)

We Will Report from Bikini

AS THIS issue goes to press word comes to us from Washington that *Power Plant Engineering* has been selected to send a member of its editorial staff to the Joint Army Navy atomic bomb tests at Bikini Atoll in the middle Pacific in July. Known as "Operation Crossroads" these tests are being made to demonstrate the effectiveness of the atomic bomb against naval vessels at sea. Since these tests are of far reaching importance, particularly to those who have followed the articles on atomic energy in this section during the past nine months, our Managing Editor, Andrew W. Kramer plans to accompany the experition and will report directly on all technical phases of the tests insofar as security regulations permit. The press representatives are scheduled to leave San Francisco on the U. S. S. Appalachian on June 12. The first test will be held early in July off Bikini in the Marshalls. The Joint Army Navy Task Force conducting the tests is planning to give fullest opportunity to cover all phases of the operation which proper security will permit.

ATOMICS

U. S. Navy Operates 3500-hp Experimental Gas Turbine at 1350 F

Built by Allis-Chalmers Mfg. Co.; under test for two years at Naval Engineering Experiment Station, Annapolis, Md. . . . Designed for 1500 F inlet gas temperature; already tested at 1350 F . . . Primary object to get data on high temperature metals and performance of components, rather than maximum efficiency . . . Instrumentation developed to obtain performance with ± 1 per cent . . . Data from unit valuable in future design of gas turbine plants for all applications

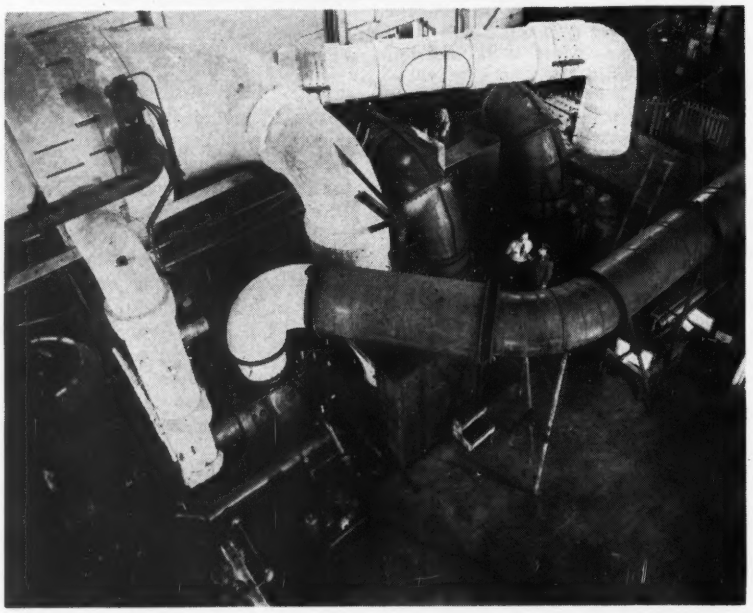


Fig. 1. General view of Allis-Chalmers experimental gas turbine plant installed at U. S Naval Engineering Experiment Station

AT THE U. S. Naval Engineering Experiment Station, Annapolis, Md., on March 29, 1946, the experimental gas turbine power plant built for the Navy by Allis-Chalmers Mfg. Co., was demonstrated in operation before representatives of the technical press. This gas turbine plant was installed at the Station in 1944 and has been under test for two years. It has operated at progressively higher turbine inlet gas temperatures as the tests proceeded and recently has been subjected to a series of test runs at 1350 F. Tests will be continued and it is expected they will soon be run with inlet temperature of 1500 F, for which the unit is designed.

Although emphasizing the experimental nature of the work to date, Vice-Admiral Earle W. Mills, assistant chief of the Bureau of Ships, pointed out that it was part of a long-term development program designed to provide the Navy with propulsion machinery of the highest reliability and maneuverability. The Navy, according to Admiral Mills, visualizes the introduction of the gas turbine into many of its ships and the experiments to date have been directed towards laying a sound factual foundation for this eventuality.

Although this gas turbine plant has been developed as a Navy project, it has characteristics applicable for both land and marine use, it was pointed out by Dr. J. T. Rettaliata, consulting engineer for gas turbines for Allis-Chalmers Mfg. Co. and director of the Department of Mechanical Engineering at the Illinois Institute of Technology.

Objectives of the Plant

This gas turbine test plant at Annapolis is designed to supply data to guide the designers of future gas turbines for operating temperatures of 1500 F.

Since this is an entirely experimental gas turbine unit, thermal efficiency was not given first consideration in its design, although it was recognized that the ability to operate at higher temperatures would improve the efficiency of any gas turbine powercycle. In this project, flexibility of operation, ease of taking essential research data at hundreds of points during each test run, and the facility of complete disassembly of any or all component parts for scheduled inspections as the tests progressed, dictated the arrangement of parts finally adopted.

The Cycle

The cycle selected for this experi-

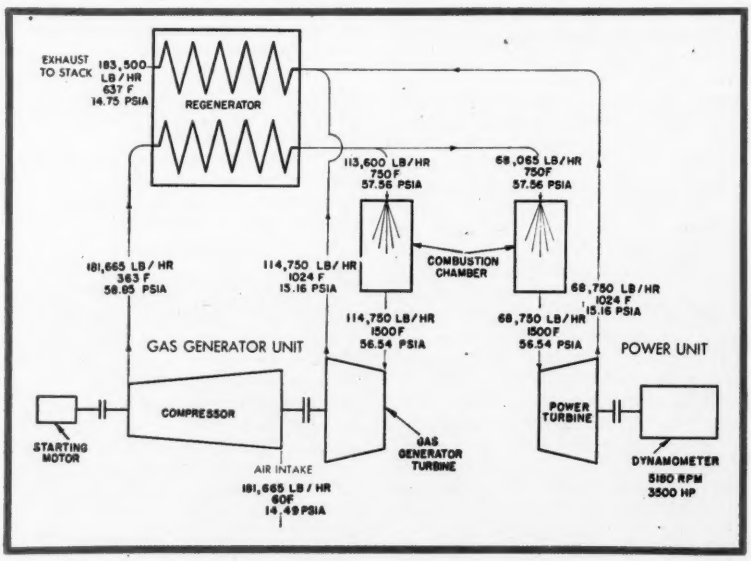


Fig. 2. Regenerative cycle of the 3500-hp Annapolis gas turbine plant arranged for special research objectives. Data for full load and temperature operation

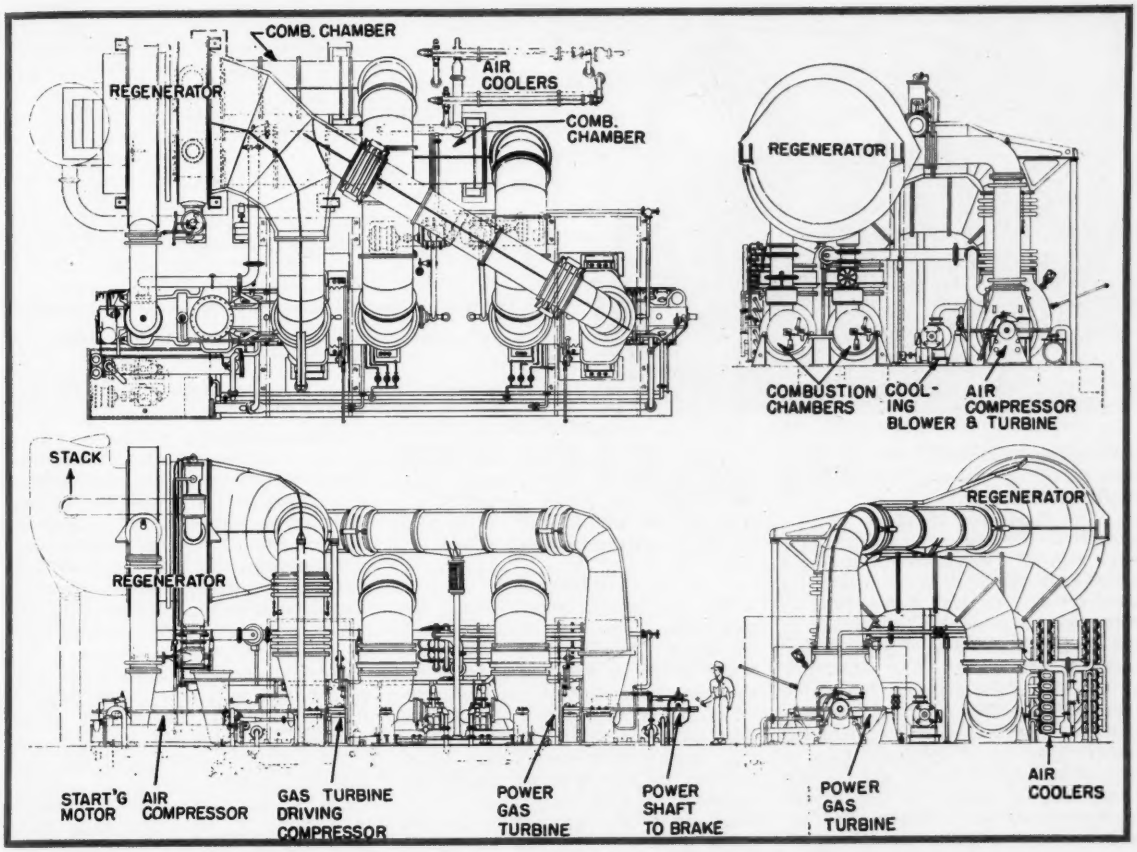


Fig. 3. Outline drawing of the Annapolis gas turbine plant, shows relative positions and sizes of its elements

mental gas turbine power unit is the parallel turbine regenerative cycle, Fig. 2. Air at atmospheric pressure enters the gas generator compressor in which it is compressed to 45 psig. The compressed air then enters the heat exchanger where, at full load, it is heated by the turbine exhaust gas from a temperature of 363 F at the compressor discharge to 750 F at the entrance to the combustion chambers.

Leaving the heat exchanger, the heated air flows directly downward into the two horizontal combustion chambers, one supplying the gas generator turbine driving the compressor, the other supplying the power turbine. With this arrangement it is possible to independently control the power generated by the gas generator and power turbines. The heat exchanger and combustion chambers are installed some distance from the unit, Fig. 3, whereas in a shipboard installation it would be necessary to place these above the propulsion turbines. The present arrangement facilitates removal of the covers of the turbines and compressor in accordance with the inspection schedule. An actual shipboard installation would be made much more compact and lighter than the experimental plant as now constructed.

Axial-Flow Compressor

The axial-flow air compressor contains 20 stages of airfoil section blades, so arranged that the air is accelerated by the moving blades and then slowed down in the stationary elements in such a manner that part of the velocity energy is converted into pressure. This compressor runs at efficiency of the order of 85 per cent when compressing the full load volume of 40,000 cu ft of air per minute against the operating head of 45 psig.

Regenerator

The regenerator is of the counter-flow type with hot gas inside the tubes, and the high pressure air on the outside to facilitate cleaning the tubes. The regenerator has an external heating surface of 8500 sq ft, and is designed to have an effective-

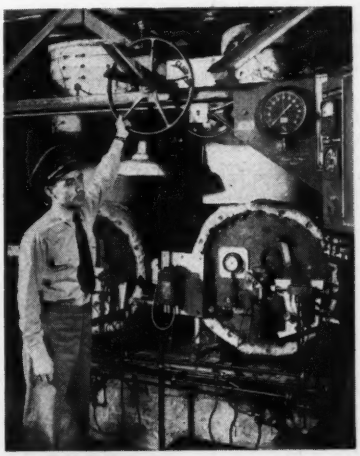


Fig. 4. Officer operating throttle valve in front of the two combustion chambers, to regulate gas flow to power turbine

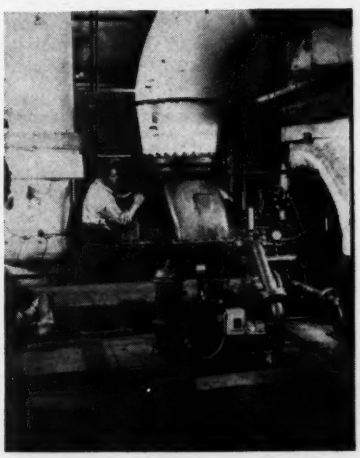
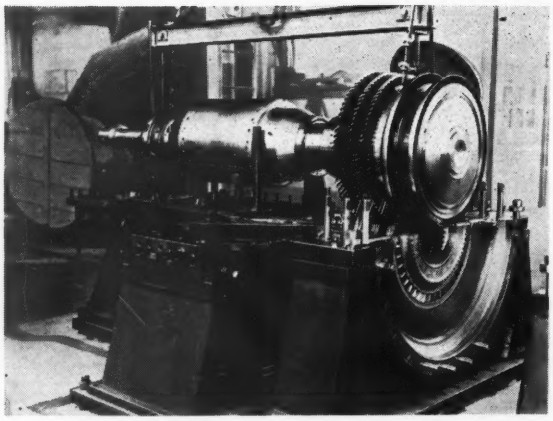


Fig. 5. Exhaust end of gas generator turbine at right. Large center pipe transmits atmospheric air to compressor



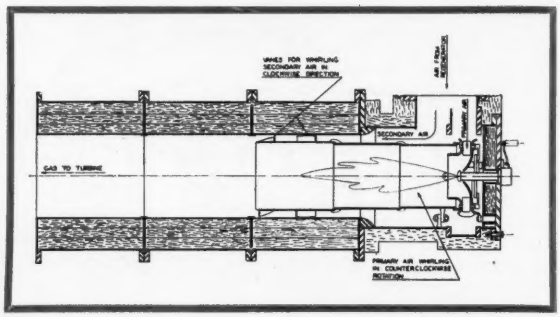

VANES FOR WHIRLING SECONDARY AIR IN CLOCKWISE DIRECTION
AIR FROM COMPRESSOR
SECONDARY AIR
GAS TO TURBINE
PRIMARY AIR WHIRLING IN COUNTERCLOCKWISE DIRECTION

Fig. 6. Left. Gas turbine spindle being lowered into cylinder of Annapolis gas turbine

Fig. 7. Above. Section of one of the two combustion chambers in the Annapolis gas turbine plant

ness of approximately 60 per cent with relatively low pressure drops on the air and gas sides.

Combustion Chambers

Each of the two combustion chambers; Fig. 7, is supplied with a single wide-range mechanical-atomizing oil burner. The central flame tube is arranged to pass the proportion of the air flow necessary to support and complete combustion. The remainder of the air flows between the flame tube and the outer wall of the combustion chamber, thereby reducing the temperature of the flame tube to a safe operating level, and at the same time avoiding the use of refractory brickwork. The cooling air and combustion gases are then intimately mixed by allowing the oppositely whirling concentric streams to come together at the end of the flame tube.

The heat release in these combustion chambers at full design load is approximately 2,500,000 Btu per cu ft per hr.

The present unit is operating with No. 2 furnace oil, adopted for the initial experimental tests because of its availability at the Experiment Station. In an ultimate installation it is predicted that fuels of grades as low as bunker C fuel oil will be used.

The form of the combustion chamber and the use of the air-cooled flame tube make unnecessary the use of brickwork, hence the unit will respond quickly to load changes, during which the power demands are met by the simple manual opening or closing of the two fuel valves.

Gas Turbines

The gas turbine which drives the axial flow compressor is substantially the same as the one that drives the water brake or dynamometer except that the compressor turbine has somewhat longer blades and is equipped with an air operated internal by-pass that is opened when starting. Each turbine has five pressure stages and operates at 5200 rpm at full load. The first two stages are of the impulse type in which the expansions from the upper to the lower stage pressures are substantially completed in each complete ring of nozzles.

The last three stages are of the conventional reaction type. The last reaction stage discharges the gas to the turbine exhaust chamber whence it passes to the regenerator and then to the atmosphere. The long extension on the turbine rotor, Fig. 6, is to balance the wheels and would be much shortened or eliminated in an actual installation.

For cooling the face of the high-temperature turbine wheel, air is carried through the outer of the two cooling tubes to a disk adjacent to the side of the high-temperature wheel. A series of holes in the periphery of this stationary disk directs the cooling air to the side of the first stage turbine wheel. The cooling air then passes radially inward over the side of the disk and thence out through the center pipe to a water-cooled heat exchanger from which it is returned to the outer cooling duct by a positive pressure blowsr.

Cooling air is similarly introduced around the periphery of the second stage diaphragm. The cooling air is supplied in sufficient quantity to about equal the leakage of the diaphragm labyrinth seal.

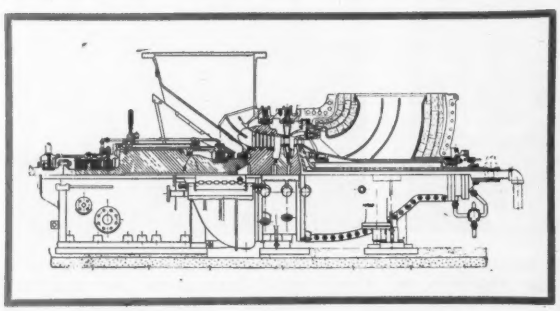
Blades and disks are constructed of a recently developed high temperature Timken alloy steel, which includes 16 per cent chromium, 25 per cent nickel, and 6 per cent molybdenum. This was developed for use particularly in the Annapolis unit, and has also had extensive service in superchargers and jet propulsion engines during the recent war. The heavy stationary parts of the turbines are made of an alloy steel containing 25 per cent chromium and 12 per cent nickel.

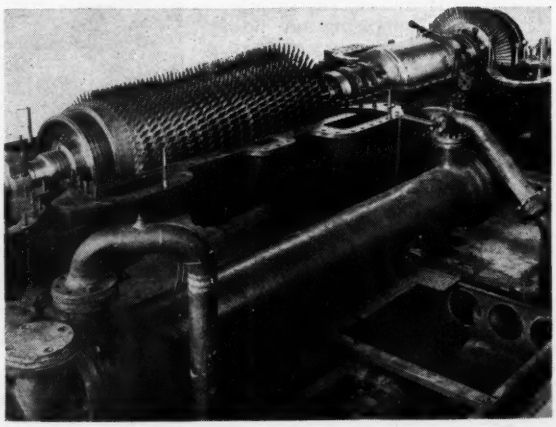
Piping

To handle the large quantities of air and hot gases circulating through the system, the air intake pipe in the Annapolis unit is 36 in. in inside diameter, and the exhaust opening of

Fig. 9. Right. Gas generator unit, consisting of compressor and turbine with top of casing removed

Fig. 8. Below. Section of turbine driving compressor, showing how cooling air is supplied to face of high-temperature turbine wheels





the gas generator turbine is 42 in. in diameter in spite of rather high gas velocities. The pipes leading from the combustion chambers to the turbines appear large because the insulation necessary to withstand the hot gases at 1500 F is inside between the double-wall construction.

In this large high-temperature piping, an internal gas guiding tube is installed with a space of approximately 9 in. between the internal guiding wall and the outside pipe. This space is filled with mineral block insulation resembling fire brick to keep the outer pipe walls down to a temperature level where their full physical strength is available.

Swing type expansion joints are installed in the piping to take the expansion occurring between room temperature and the high initial operating temperatures. These joints consist of a series of radially placed hinges between the flanges, arranged so that the rotation of the adjoining members relieves the dimensional changes of the piping resulting from thermal expansion without distortion of turbine and compressor parts.

Testing Procedure

The test plans include the operating of the unit for established periods of time under prearranged operating conditions, with gradually increasing turbine inlet temperatures. Each test operating period is followed by a complete disassembly and a full inspection with numerous measurements to determine what changes in high-temperature parts have taken place including a development of any possible cracks and observations of the resistance to oxidation.

With the two shaft arrangement it is possible to operate the gas generator turbine and the power turbine at different speeds, pressure ratios, and rates of gas flow, thus determining the characteristics of the turbines and the axial flow compressor over a wide range of conditions.

Both the gas generator turbine and the power turbine were operated at full speed of 5200 rpm for over 50 hours in November, 1945, with exceedingly smooth operation and subsequent examination revealed an excellent condition of all parts. These runs were made with 1200 F inlet temperature on the power turbine and 1100 F on the gas generator turbine.

Continuing the test schedule, 50 hour runs were recently made with inlet temperatures of 1350 F on the power turbine and 1200 F on the gas generator turbine, again with very smooth operation and no serious complications or indications of distress in the high temperature rotating elements.

Occasional minor mishaps have developed during the testing, but so far these have been overcome without serious difficulty, and the unit is delivering its expected performance.

Instrumentation and Testing of the 3500-hp Navy Experimental Gas Turbine Plant

By LT. COMDR. C. F. KOTTCAMP, U.S.N.R.

THE BUREAU OF SHIPS requested that the Station determine overall performance of the plant as well as the performances of the turbines, compressor, combustion chambers, regenerator and piping losses. The Bureau stipulated the accuracies desired for the various test items, and the investigation was to be of sufficient accuracy to yield data as to their efficiencies and power requirements to within ± 1 per cent. To obtain this information, instrumentation accuracies were specified as follows:

(A) Temperatures—
  (a) up to 500 F ± 1 F
  (b) 500 to 1000 F ± 2 F
  (c) 1000 to 1500 F ± 3 F

(B) Pressures—
  (a) up to 30 psia ± 0.03" Hg
  (b) above 30 psia ± 0.1" Hg

(C) Flow Readings—
  (a) fuel ± 0.1%
  (b) inlet air flow ± 0.5%
  (c) turbine gas flow ± 1%

(D) Torque Output of Power Turbine ± 0.25%

(E) Rotational Speed—Since speed is the primary variable for evaluation of compressor performance and is also the primary reference against which all test data will be plotted, it was important that it be determined as accurately as possible, and a desired accuracy of 0.1 per cent was set.

Temperature Measurements

After several months of basic study, a satisfactory solution of the temperature measurement problem, was reached with the development of a probe-type thermocouple completely built into ⅜ in. stabilized 18-8 stainless steel tube. Using this thermocouple, accurately measuring the duct wall temperature, mathematically correcting for the thermocouple radiation losses, we can obtain the gas stream temperature within ± 4 F at 1500 F.

Another difficulty was that, particularly in the ducts carrying the hot gases from the combustion chamber to the turbine inlet sections, there was a decided gas temperature stratification, hence we had to obtain a detailed stratification pattern in order to calculate the effective temperature of the gas stream entering the turbine.

Determining Combustion Efficiency

Another item of importance in evaluating the performance of the gas turbine plant is the determination of the efficiency of the combustion process. This is complicated by the fact that these engines require approximately 500 per cent excess air. Conventional types of instruments, for example, the Orsat gas analyzer, are entirely adequate for analysis of stack gases from boilers operating with 30 per cent excess air, but are of little value in determining the constituents of the gas turbine exhaust.

The Bureau of Standards had encountered the same thing in attempting to determine the combustion efficiency of the fuel chamber of some captured enemy jet-propulsion engines. They, however, had developed a unique combustion train method of burning out the very small percentage of unburned hydrocarbons, carbon monoxide and hydrogen, which, when combined with other analytical equipment resulted in an overall combustion efficiency determination to within ± 0.5 per cent. With the cooperation of the Bureau of Standards, the Station built a modification of this gas analysis method and is now using it for determining combustion efficiency of the Allis-Chalmers gas turbine plant.

During the war, trained personnel was scarce and data were needed quickly. The Station decided, therefore, to plan an instrumentation layout for obtaining not only the accuracy of test data as requested, but also to yield maximum information in minimum time with minimum test crew. The instrumentation was to be so designed that at any given operating conditions a complete set of readings from all instruments would permit calculation of all required information. To accomplish this, for temperature measurement alone, it was necessary to install 66 thermocouples distributed throughout the unit and utilize nearly a mile of thermocouple wire and cable in their interconnecting thermo-electric circuits. A total of 72 mercury-in-glass thermometers were installed at various locations to obtain temperatures of fluids flowing. A total of 49 test pressure gages and 44 manometers requiring approximately 3500 ft of ¼ in. connecting copper tubing were also installed.

During the seven hour test period approximately 2000 individual readings were systematically recorded. To calculate all the resulting thermodynamic and performance results two types of calculation are required. In one, the raw data can be employed directly in the mathematical calculations. In the other, the data must be processed before it can be used in calculating the final results. The calculations have been reduced to a minimum by the use of about 20 charts and monograms.

What the Power Engineer Needs to Know About

BINS, BUNKERS, AND SILOS FOR COAL

In previous articles Mr. Hudson has discussed the various methods of handling coal. In this article he presents valuable comments on storage, including ... Outside storage ... Bin storage ... Silo storage ... Silo costs ... Bunkers ... Arching ... And references to additional instructive reading on this subject

By Wilbur G. Hudson

Consulting Engineer

PREVIOUS articles have discussed the various machines available to the engineer for handling the coal from the cars to storage and some comment on the storage itself may be of value.

Nearly every engineer of small and medium capacity steam plants has faced the problem of reserve storage and has weighed the comparative advantages of bins, bunkers or silos. Rather oddly, in the writer's observation, some sections of the country seem to go in for one type of storage, while others favor another. Possibly climate has something to do with this. Some coals are so prone to spontaneous ignition that storage is risky, since circulation of air through the mass causes the oxidation that leads to ignition, and circulation is difficult to eliminate completely. At one plant in Indiana, where the reserve ground storage was a flat pile only 3 or 4-ft deep, it was observed that the flanks of the pile were extensively ablaze. This happened to be a state penal institution so labor cost was zero, but there was a serious loss in heating value which could have been greatly reduced by using the free labor to compact the mass by rolling, or sealing it by spraying with emulsified asphalt. Every engineer knows that some coals are dangerous for storing, and specifies his coal accordingly.

Outside Storage

Outside storage suffers less loss by weathering than is generally thought. Extended research by the Bureau of Mines with New River, Pocahontas, Pittsburgh Gas, and Sheridan Wyoming coals showed that outdoor weathering caused no loss greater than 1.2 per cent the first year or 2.1 per cent in two years. The sub-bituminous Wyoming coal suffered somewhat greater loss, 2 to 3 per cent in the first year and up to 5.5 per cent in three years.

Bin Storage

Many of the older small plants have a covered bin opposite the boiler room into which coal is shovelled from the cars through window openings, and from which it is shovelled to the stoker hoppers. The first is more laborious, and a simple mechanical unloading installation is well worth while. A reclaiming conveyor to handle from the bin can show no operating economy, since the fireman attends either to the shovelling or to the conveyor. However, the job is more attractive with a conveyor—a factor that just now (July, 1945) warrants some consideration by the employer.

By extending the elevator upward as in Fig. 1, some of the coal unloaded may be chuted direct to the stokers, and some may be reclaimed from bin to elevator—but the installation begins to run into money.

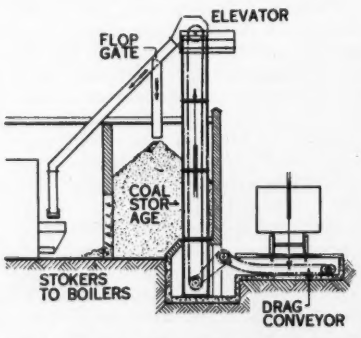


Fig. 1. Storage bin with car unloading equipment providing for by-passing coal to stoker hopper

Silo Storage

The silo, either with a hopper near the top (Fig. 2), or an upper sloping floor to form a live storage, and with the elevator so arranged that it can reclaim from reserve to live storage compartment is favored by many operators. The shelf should be at an angle of at least 50 deg. with the horizontal since the angle formed by the junction of the shelf with the perimeter is substantially less than the slope of the shelf and a 45 deg. shelf backs up a considerable percentage of the coal.

With coal subject to heating the gate openings should have close-fitting gates to reduce to a minimum ingress of air. Breaking up a big clinker inside a silo is a difficult job. Where winters are severe, the coal may freeze in an exposed silo, so hollow tile construction is preferred as providing air gap insulation. Monolithic concrete has some insulating effect and steel plate practically none. When freezing is likely the continued injection of a very small quantity of live steam will keep the coal flowable. Heating coils are better but more costly.

Silo Costs

Single unit tile or monolithic silos with live storage compartment, and total capacity of 200 to 300 tons cost about $17 per ton of capacity, including the average foundation ring. This figure varies widely for smaller silos, since much of the cost is in connection with the set-up for the work which is not much more for a large silo than for a small one. Steel silos cost about twice as much and are less desirable because of maintenance cost.

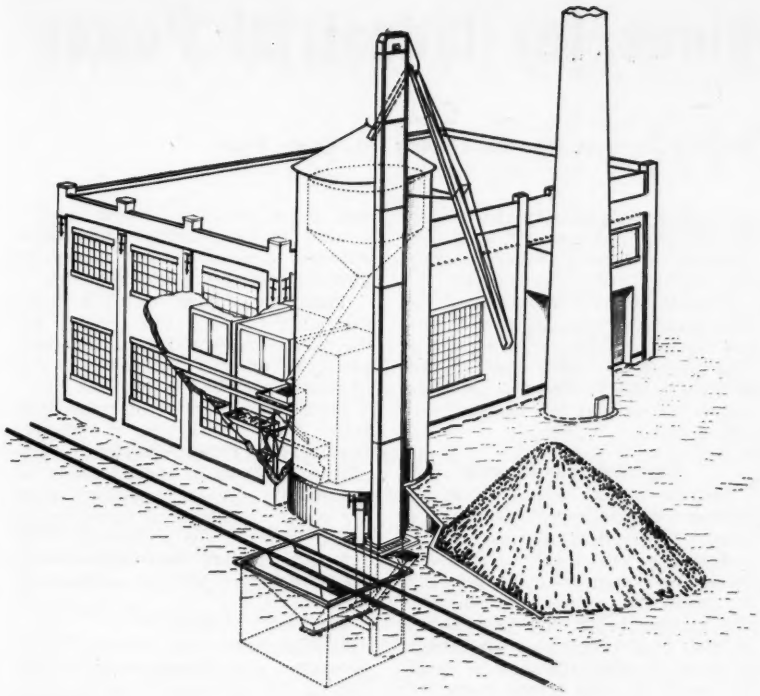


Fig. 2. Diagrammatic drawing showing silo on power house

Bunkers

Small inside overhead bunkers, exclusive of supports, cost about twice as much as a concrete silo of equal capacity. Somewhat larger bunkers cost about $25 per ton. These figures refer to suspension bunkers which, for the small plant, are preferable to framed structures because they require much less weight of steel. Bare steel plate is subject to corrosion. A concrete lining on steel plate increases the cost substantially. A very economical type of suspension bunker is formed by steel straps on which a special form of thin steel sheet is placed and then a waterproof sand-cement lining. This costs about midway between an unprotected steel plate bunker and a steel plate bunker with gunite lining. Figure 3 shows one bunker of this type installed by the writer 30 years ago which is in as good condition today as when erected.

Fig. 3. Suspension type bunker protected inside and outside with concrete lining. Outside facing is white cement and lime to reflect light downward into boiler room

The bunker has the advantage over the silo that should any section of coal heat up, it may be withdrawn continuously until the trouble ceases. Heating may occur from air circulation up through the discharge gates or downward along the flanks and up through the central section. This last offers the possibility of quenching by packing dry ice (solidified CO_2) along the top edges when a fire is noted or feared.

Arching

With the finer sizes now common there is encountered more difficulty from coal hanging up in a silo or bunker. Compressed air jets will sometimes break down such arching. A suspended sheet of 24 ga. stainless steel is frequently effective in preventing the formation of an arch, even with pulverized coal.

Instructive reading: Deterioration in Heating Value of Coal in Storage, Bureau Mines, Bulletin No. 136. Spontaneous Combustion of Coal, Bureau Mines Information Circular, No. 7074. Quantity Storage of Bituminous Coal, by Joseph Harrington, Northern Ill. Coal Trade Assn. 310 S. Michigan Ave., Chicago, Ill.

Steam Power Launches Buzz Bombs

LAUNCHING the "buzz bomb" by boiler-developed power is a new application of steam propulsion achieved by The Babcock & Wilcox Co. Only the German collapse following the failure of the Ardennes break-through prevented the development having active combat use in World War II.

The Germans had developed a chemical means of launching their bombs, but it involved considerable hazard to the operating crew. The work of the Babcock & Wilcox engineers materially reduced the launching hazard. What they did was to design and manufacture equipment to provide high-pressure steam in sufficient quantity to accelerate a load of 5000 lb to a velocity of 250 miles an hour within a distance of 150 ft, the travel of the German-made ramp.

This required equipment designed for 1200 psi to handle steam at the rate of 3,000,000 lb per hour with a valve having an opening and closing time of 0.03 second, the valve being open 0.8 second, the time required for the bomb to travel the 150 ft of the ramp. The Babcock & Wilcox Co. designed and built this equipment, cooperating with Manning, Maxwell & Moore, of Bridgeport, Conn., in the design of the valve. The equipment was built, shipped and installed at Eglin Field, Florida, and made ready for operation by the middle of March, 1945, and trials were conducted during several months following.

Both dummy projectiles and real buzz bombs were launched out in the Gulf of Mexico. The bombs detonated on impact. During the launching, the steam equipment developed a peak of 25,000 hp, averaging 20,000 hp. The energy stored in the steam equipment, if completely released, amounted to 57,000 hp. It required only approximately ten gallons of oil or gasoline to provide the energy for each launching.

Texas Hydroelectric Station

BRAZOS RIVER CONSERVATION and Reclamation District, Temple, Tex., has plans under way for new hydroelectric power development on Lampasas River, near Belton, Bell County, consisting of a power dam, generating station, switchyard and auxiliary structures, estimated to cost about $7,450,000, including transmission and distribution lines. Ambursen Engineering Corp., 295 Madison Ave., New York, N. Y., is consulting engineer for design and supervision of dam construction. Another project is being considered at Mineral Wells, for hydroelectric power development, with concrete dam, generating station and accessory structures to cost approximately $4,420,000. Financing on first mentioned project is being arranged, and work is expected to begin in near future.

Extraction Turbines for Industrial Power*

By L. E. Newman Turbine Division, General Electric Co., Lynn, Mass.

POWER AND STEAM are furnished by the industrial type steam turbine, but these are not its end products. Its end products are soap, or paper, or chemicals, or gasoline, or some other product of our inventive age.

The relative thermal efficiencies of different turbine types operating with and without process steam demands are shown in Fig. 1.

The most efficient power generating station in the world, having the making of power its sole job, has an efficiency of less than 40 per cent. Industrials with demands for process steam that are balanced with their electrical load demands can easily top this 40 per cent. The most efficient power generating cycles known today discard, in the form of warm water, over half of the heat energy initially in the fuel. This heat is usually at a temperature of less than 90 F.

The industrial turbine also converts fuel into power, but instead of discarding the heat energy remaining in the exhaust steam, it sends this steam to a process. The process is charged with the heat it receives, for whether the industrial makes its own power, or buys it, it still has to supply the process with the heat it requires.

Everything But the Squeal

The result is shown in Fig. 1. Non-condensing turbines, with a process to take their exhaust steam, leap in thermal efficiency from 10 per cent to 80 per cent—including boiler losses. The efficiency of 80 per cent holds for non-condensing and non-condensing-extraction types of turbines.

In a condensing, single-automatic-extraction steam turbine, when the load is carried by the head end of the turbine—large process steam demand—the power plant efficiency approximates 75 per cent. When the load is carried by steam flowing to the condenser, the efficiency falls to perhaps 20 per cent. It is significant to note that this type of turbine now accounts for nearly half of all industrial turbines sold today.

Flexibility of Condensing-Extraction Units

These condensing-extraction turbines are the most flexible of all turbine types. When there is a demand for process steam, they supply it along with the electrical load requirements. When there is no process steam demand, they continue to carry the electrical load. They adjust themselves automatically to the changing demands while holding constant speed, and while holding one or more process pressures constant. Thus they maintain a balance between steam and electric load requirements.

In 1930, the average industrial turbine purchased was designed for initial steam conditions of 240 psi, 500 F. This has climbed to a 1945 average of 475 psi, 680 F. There is good reason to believe that this upward trend will continue.

Varied Industrial Demands

Because of the difference in end product—soap, paper, chemicals, or gasoline, instead of only electricity—and the fact that the turbine may burn up its own price in fuel every six months or a year, the ability of the turbine to fit the job assumes unusual importance. This has brought about so many variations in design that, over the past fifteen years, it is doubtful if there are a dozen duplicate turbines, excepting those bought as duplicates by a single owner. In the range of ratings 500 to 7500 kw, there are now fourteen standard ratings and eight basic turbine types—a total of one hundred and twelve different designs, caused simply by difference in rating and type.

These are simplest variables in design of a turbine. Far greater are the variations caused by initial pressures, by exhaust pressures, by one or more controlled extractions.

Industry uses power at frequencies from 25 to 180 cycles, at voltages from 240 to 13,800, and the turbine must sometimes fit special space requirements. Taken together, there are many thousands of variations to which turbines are commonly fitted.

It is likely that the trends towards standardization will be along these lines:

(1) Fewer ratings.

(2) Less variation in initial steam pressures and temperatures, accompanied by a trend towards more high-pressure units and fewer low-pressure units.

(3) Fewer variations in generator voltages, particularly, a marked reduction in low voltage units.

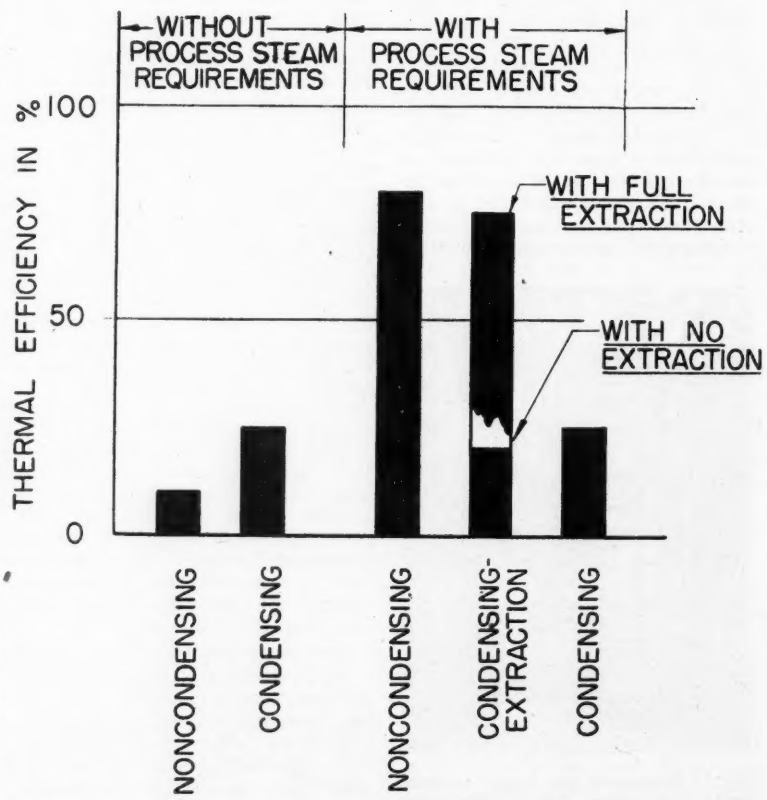


Fig. 1. Curve of relative thermal efficiencies of different types of turbine, with and without process steam demands. Boiler efficiency included at 85 per cent

*From a paper presented before the Midwest Power Conference, Chicago, Ill., April 5, 1946.

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

Ye Olde Practikal Engineere

Old Timers **in the field of steam engineering familiar with the history of *Power Plant Engineering* may know that the magazine was started under the name Practical Engineer in 1896. It was published under this name until 1918 when the present name, *Power Plant Engineering* was adopted. Unfortunately many of the early numbers of the Practical Engineer are no longer in existence, at least not in the libraries, nor in our own files. We have recently made a search for the early numbers, particularly those comprising Volume I without much success, however. The Franklin Institute in Philadelphia was found to have copies of issue No. 10, Volume I and Number 11, Volume II, but no trace can be found of the early issues of Volume I. Since we are desirous of getting hold of these early issues or at least learning of their whereabouts we are making this appeal here. It is thought that some of the old timers may still have copies of some of these early numbers stored away in attics or even in their active libraries. If so we would like to know about it and if possible have photostat copies made of them. If any of you have any of these early issues please communicate with us at once.**

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE
Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

The Sad Case of the Ailing Corliss

Here is another case, reported by William White, of how not to run a power plant. This one deals with a so-called power plant serving a sawmill. Reading it is enough to make any conscientious engineer's hair stand on end, yet it is not exceptional. As, Mr. White says, what is the use of trying to educate engineers when owners permit plants of this kind to operate?

By WILLIAM S. WHITE

IN RELATING this experience I feel more than ever, that it is a mistake for technical magazines to devote their pages to engineers and their education. It seems to me, that it is the employers of engineers, the managers and owners of plants, who need uplifting, rather than the engineers, if for no other reason than the sake of their pocketbooks. It is possible, of course, that they do not want to be uplifted, it may be that they make enough profit, so that any bastardized power plant setup fills the bill. At the present time, in these parts at least, I notice that although much could be charged to depreciation and probably is, power plants seem to be the last place that receive any consideration in this respect.

Some time ago, I received a call from a sawmill company to come down to their planer mill, as they put it, to adjust a corliss engine which ran the mill but which was not developing the power they expected it should. Having in my possession a steam engine indicator, which was lucky for them and for myself as events subsequently proved, I took it along with some other tools and started out to find the mill which was on a loop line of the Canadian Pacific railway, which gives service to a section of the country west and south of Edmonton, back into what is called the bush and foothill country. After a slow leisurely jog-along trip in the train, I finally found the mill right beside the railway track at a place called Winfield.

The So-Called Plant

The situation that presented itself as a small power plant, was a single 150 hrt boiler fired with shavings, which were burned in a semi-dutch oven with the usual setting of around 6 ft between the grates and the bottom of the shell, with the obviously usual lack of furnace volume, for the sake of a few more bricks, and a few more feet of steel on the supporting columns of the boiler. The boiler room itself looked as if it had been stricken with the palsy. It had been intended as only a temporary arrangement some 15 years ago.

About 200 ft away I found the corliss engine in a room by the side of the mill. It was laboring along with steam supplied through a 5-in. line stretched overhead from the boiler. This line had been subjected to a patchwork lagging job, part of the line being covered with insulation which had been generally accepted as standard for and up to steam of 15 lb gage pressure. No provision had been made for expansion and achorage except in what appeared to be an accidental gooseneck drop from the boiler vertical outlet branch. This gooseneck was placed at an angle of 30 deg or so to the run of the main steam line. A large sized leak at the bottom of the gooseneck, where an elbow turned the main line to the horizontal, was blowing right merrily and one was able to observe the varying wet and dry steam issuing from the leak.

The steam main ran straight to and down into the engine throttle, through a vertical leg which was about 20 ft long and this was plainly taking care of some of the expansion of the horizontal steam line, as it was far off plumb in the direction one would expect. Of course, there was no receiver separator above the engine throttle, this would have been too much to expect.

I Set Up the Indicator

To set up the indicator, I was presented with several pieces of old bent 1/2-in. pipe. The indicator outlet on the cylinder of the engine was closed with two 1/2-in. globe valves. After some trouble with old elbows, and an ancient set of pipe dies, the indicator cock was installed, and the indicator set up. The engine itself was a 16 x 36 x 100 rpm double wristplate corliss, and from appearance, the makers had spared no pains in building it. The valve motion mechanism, however, had been altered and changed a great deal, and generally the original shop tram marks on the various rods for proper length did not conform. One repair that had been made on the head end steam valve in fitting a new valve stem, showed that the keyway of the lifting arm had been cut wrong in relation to the tee head that turned the valve, and to meet this, the reach rod had been shortened, and the dashpot rod lengthened to maintain the lap required. The counter weight of the governor showed that a large piece had been turned off to lighten it, although as a general rule these weights are hollow cups into which lead shot is added for balance.

The indicator as a gadget caused a great deal of curiosity among the mill hands. It was quite obvious that they had never seen anything like it and they took turns at relieving one another so that all could have a look at it. There was quite an audience to view the taking of the first cards.

After a few minor adjustments a few cards taken showed that there was very late admission on both sides of the cylinder, with the head end the worst. There was a very decided drop in the steam line and the card looked more like what would be gotten from a slide valve engine, as will be seen from the first card shown in Fig. 1. The decided fall in the steam could hardly be attributed to pressure drop in the long steam line from the boiler. So I tried the throttle

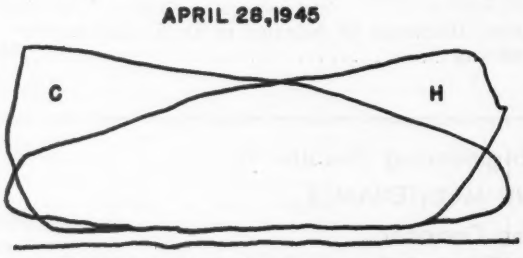


Fig. 1. This is the first card taken, showing the valve setting as found

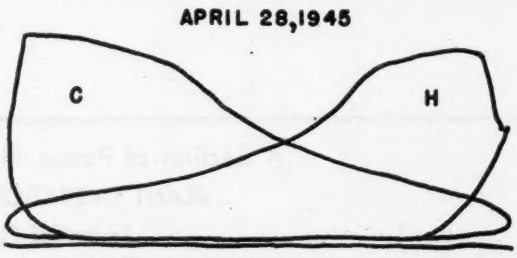


Fig. 2. This is a card with the original valve setting but with the throttle fully opened

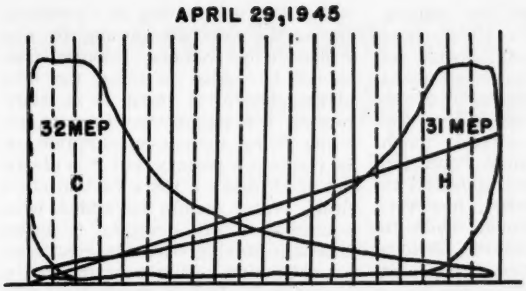


Fig. 3. This is a card taken after the valve setting had been corrected and when running with no load

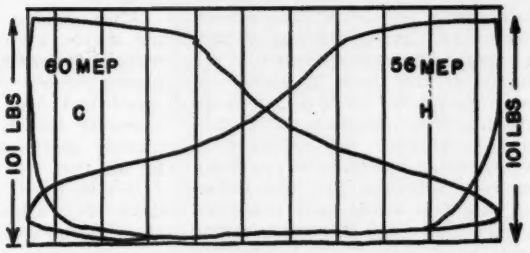


Fig. 4. Card taken with the valve setting corrected and with the engine running with load

and found that the engineer had been running the engine with the throttle open only about 1½ turns. When I called his attention to this he said that he had to do this to hold the steam. After opening up the throttle, a card (Fig. 2) with some resemblance to a corliss engine card was obtained. Incidentally, the engine speeded up a number of revolutions with the governor behaving very erratically.

The evidence from the diagrams pointed to the major adjustment being required on the steam valve eccentric, and as the day's run was about finished by the time the cards were taken nothing further was undertaken until Sunday. On Sunday, in the forenoon, after various trials the steam eccentric was advanced far enough around the shaft until a very fair corliss engine card was produced and about as good as circumstances would allow. Some attention was also given to the governor, and a weight provided to make up for that taken off the counter weight, and much better governing of the engine speed resulted.

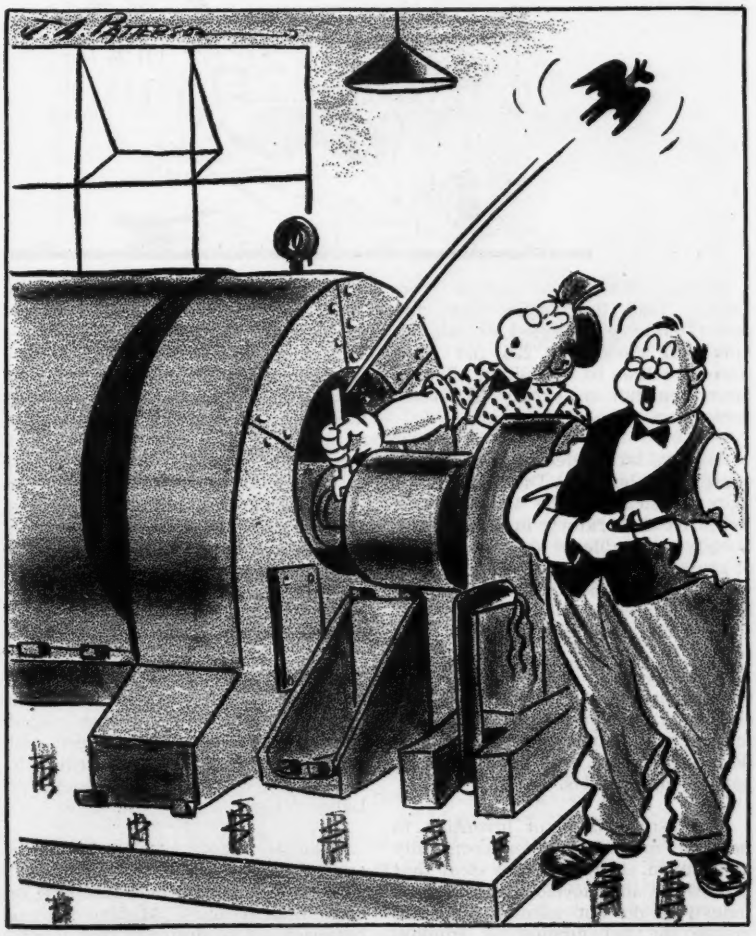
112 hp for Friction Load

With no load on the mill, it was found that 112 indicated hp were required to take care of the friction load alone. It was also seen that there was a decided drop in gage pressure between the boiler and the engine, a drop of about 25 to 30 lb when the admission line on a card and the boiler gage pressure were compared. It was, as would be expected, impossible to get dry steam at the engine, and this with the drop in the steam line affected the steam consumption of the engine in a large degree. With the regular load on the mill during Monday forenoon, further indicator cards taken showed there was an average indicated horsepower of 225, the difference between this and the friction load of 112, taking care of the power required by one double planer, a resaw, and the shaving blower, representing all told, 114 indicated horsepower.

It was very obvious that the boiler was producing a large amount of steam, that was doing absolutely no work at all. This steam was lost in the friction load, in the main steam pipe condensation plus priming passing directly through the engine for the lack of a very necessary piece of apparatus—a receiver and separator at the engine—and the loss from the reduction of boiler pressure at the throttle from 130 psi to 100-105 psi. The total loss was probably 60 per cent of the nominal boiler rating, and as there was another double planer standing idle in the mill, this could have been in operation also if the plant had been made to comply with the most ordinary engineering principles. Undoubtedly all the lumber that could be finished was needed somewhere and certainly all that was planed was shipped.

With an engine flywheel 14 ft in diameter belted up short to a line shaft pulley about 4 ft in diameter, and a very heavy belt tightener sitting on a tight belt in which there was no sag to allow the belt to wrap around the driven pulley, one was left wondering just what amount of power was wasted at this point.

Another bright touch in this plant was the 6-in. exhaust line carried back from the engine to the boiler room. This line was buried under-

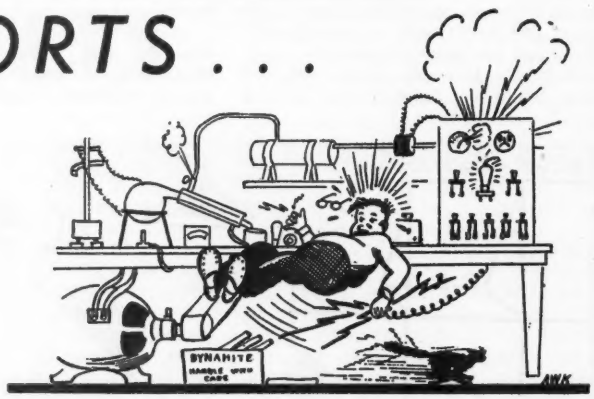


"No that hasn't been run for some time—why do you ask?"

ground with various elbow fittings and connected to a closed feedwater heater. This pipe maintained a back pressure of 6 psi on the engine with no atmospheric outlet provided at the engine. If this back pressure had been reduced by, say 4 psi, it would have meant a reduction of 14 indicated horsepower and of course a corresponding reduction in the steam required. I figured that this reduction in steam would have amounted to from 300 to 400 lb per hr leaving plenty of exhaust steam for heating feedwater and for other purposes such as heating of buildings. Aside from that used for heating feedwater there was plenty of exhaust steam available for other heating purposes, but not one pound of it was utilized. Another straw that was breaking the camel's back was the live steam heat provided for the saw filing and knife sharpening room. No attempt of any kind had been made to take advantage of the heat going to waste in exhaust steam, except for heating feedwater.

After making the adjustments on the engine, a steady governed speed was maintained and the output of the planed lumber went up, and as the speed had been increased, much smoother boards resulted from the planing operation. This appeared to be all that was expected; however, I felt it might be worth while to draw their attention to the obvious facts of the situation as it appealed to me, which, of course, has been more or less covered in this article. The engine was capable of developing some 300 indicated horsepower nicely. It was easily possible to maintain 120 to 130 psi gage at the throttle of the engine. The MEP pressure of 82 psi would, with a cutoff of ⅜ of the stroke, develop the 300 indicated horsepower and the steam used per hour by the engine would be around 6500 lb per hr.

SHORTS . . .



DURING THE 5-year period from 1939 to 1944, the electric light and power industry increased its sales to industrial customers 225 per cent, from 51 billion to 115 billion kilowatt hours—enough to supply 27,000,000 homes for over 3½ years.

* * *

A NEW, large electro magnet designed and built by Dr. J. E. Goldman, physicist at the Westinghouse Research Laboratory in East Pittsburgh, is capable of exerting a pull of some 4000 lb. The magnet is wound with a coil of 64,000 turns and the heat generated by the current flowing through this coil is around 28 kilowatts. To cool the magnet, Dr. Goldman has to circulate 15 gallons of oil a minute through these coils. Although a wartime aid, the electro magnet will be used primarily in the development of new and stronger permanent magnets.

* * *

THE RELATIONSHIP of invention to unemployment has never been fully determined. However, it is clear that inventions and development of new industries do not automatically increase the net amount of employment. Otherwise jobs would have been begging for men in 1932 and 1933. The following are some examples of job losses due to mechanization: A coal mine employing 800 men installed a loading machine and displaced 500 of them. One wrapping machine with one operator replaces as many as 40 hand wrappers. The steel mills have introduced machinery that permits 1600 men to do the work formerly done by 32,000. In 1830 it took 268 man hours to produce 100 bushel of wheat on 5 acres. By 1930, 40 man hours were sufficient to accomplish the same results. A Western Union device known as a floating switchboard, operated by 6 persons, automatically writes telegrams anywhere in a large district doing the work of 49 persons. In 59 manufacturing industries the output per man hour increased 91 per cent between 1919 and 1938, according to figures taken from a Department of Labor report.

* * *

ENOUGH ENERGY can be stored in an ordinary storage battery to lift its own weight well over 32,000 ft or more than 6 miles. Modern storage batteries are so designed that practically no water evaporates from the cells. The loss is due to decomposition of the water by gassing. No acid is lost in this manner. Enough water should be added to bring the level of the electrolyte about ½ in. above tops of the separators. Usually any water fit for human consumption can be put into a battery, but it is always better to make a more certain check first. Water should be added when necessary before charging to insure thorough mixing with the electrolyte when gassing occurs near the end of the charge. This is particularly necessary in cold weather. Otherwise water not mixed with electrolyte may freeze and ruin the cell.

* * *

SOME ASTONISHING facts about wood are given by Dr. Carl C. Forsaith of the New York State College of Forestry, Syracuse University. A cubic inch of white pine, weight for weight, is stronger than common steel. When it is air dried it will support the weight of nearly 2½ tons lengthwise to the grain, although three-quarters of its volume is air.

The block contains between 4 and 5 million cells of a certain type called "tracheids." If placed end to end, these cells would reach more than ten miles. White pine has three other kinds of cells. Organic matter constitutes approximately 99 per cent of the wood.

* * *

MOST COMPANIES today require their cost accountants to determine the cost of each operation in each department. Yet, many of them arrive at their steam cost by simply dividing the total cost of steam for plant operation by the number of departments. This method of determining steam cost in many plants has led to false operating efficiency because it has been definitely proved that the quantity of steam used not only directly effects the cost of processing per unit of product but in some cases, the out-quality of output. For example, a nationally known manufacturer of molded products, installed flow meters on departmental steam lines. To the surprise of the plant officials it was found that power engineer "A" was saving $500 worth of steam per month. In the processing department foreman "B" was wasting $500 worth of steam per month. On the books the waste cancelled the saving.

Investigation, however, showed that the processing operators had habitually neglected to close the steam valves properly. As a result, power engineer "A" was not getting credit for saving fuel. This careless waste of steam meant a net loss of $1000 to this company.

Too often the power engineer's services end when he produces steam economically. What happens to it after it leaves the boiler, how efficiently steam is used, is just as important as the efficiency in the power plant proper.

Diesels Provide Low-Cost Power for Cold Storage

By Francis A. Westbrook

L. G. HAVILAND & SON, Highland, N. Y., operates a cold storage plant completely powered with three diesel engines. They were installed after the former power plant had been destroyed by fire, and were selected because, for the conditions here, they offered greater economy. The management figures that it is saving half the cost of using outside power.

One of these engines, rated at 55 hp, drives a 6 in. by 6 in. York ammonia compressor by means of (Link-Belt) multiple V-belts as shown in Fig. 1. This picture also shows the large speed reduction and the short distance between centers for which this type of belt drive is so well adapted. Another diesel engine, of 82 hp, drives a 7½ in. by 7½ in. ammonia compressor with a similar transmission. Both engines are equipped with clutches by which the load may be gradually applied to each after it has been brought up to normal speed.

These ammonia compressors are operated in tandem at such times as particular requirements make it necessary. In general, however, only one of them is run at a time, and then continuously for a month with only one or two stops for oil changes, etc. Each is provided with devices for protection against water circulation failure and excessive frosting.

A 34 hp diesel-electric unit, shown in Fig. 3, completes the power plant. It provides lights for the plant and electrical power for escalator motors and other equipment. In this instance the engine is direct-connected to the generator.

Each engine has been equipped with sheet metal ducts to dispose of the heated air. The two engines driving the ammonia compressors have blower type fans for exhausting the hot air from around them and through the radiators into the atmosphere through a vent in the roof of the engine house. In this way the engines continuously receive a supply of fresh air, and the hot air is not recirculated. The smaller diesel-electric set has a suction type fan and, being the smallest engine in the plant, provides the fresh supply of slightly warmed air. In summer the doors and windows of the engine house are left open to assure an adequate amount of as cool air as possible.

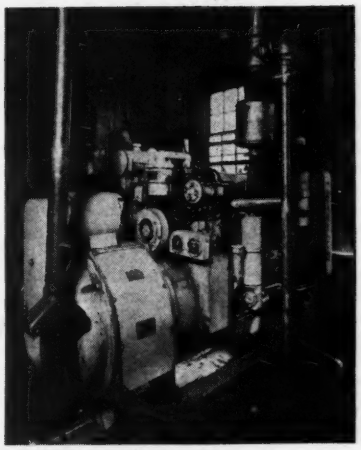


Fig. 3. 34-hp Diesel-electric plant furnishes light and power for motors

Fig. 2. (Right) The L. G. Haviland & Son cold storage plant at Highland, N. Y.

Fig. 1. (Below) 55-hp Caterpillar Diesel engine driving a 6 by 6 in. York ammonia compressor. Note large speed reduction with short center distance

When the three engines are running the fuel consumption is 125 gallons in 24 hours and each normally uses two quarts of lubricating oil in the same length of time. At least two of the engines are in continuous operation throughout the 24 hours of the day.

An engineer is on duty for each of the eight hour shifts. Their main responsibility is not so much to watch the engines as the refrigeration equipment. They also check for belt breakage, water pump failure, etc. According to the manager the engines re-

quire very little attention while running.

The company states that it has had remarkable success with this diesel power plant. The cost of maintenance and replacement parts has been particularly low on all of the engines. Preventive maintenance measures consist of periodic checkups which result in putting in new sleeves, pistons, fuel injectors and pumps once in a while and new crank shafts for the starting engines when the need is indicated.

PRACTICAL HINTS AND KINKS

Shop Ideas for Finishing Metal Parts

TWO SHOP-MADE holding fixtures that provide power brushing with a new and effective means for fast output of properly cleaned and deburred metal parts, were recently reported to The Osborn Manufacturing Co. of Cleveland, world's leading manufacturer of power brushes.

One is a hand-made pair of forceps for holding tiny splines against a brushing wheel for removal of burrs and other surface irregularities (see Fig. 1). The use of different sized holding heads makes this idea applicable to various sizes and shapes of parts to be brushed.

The other shop-born idea is for stepping up production in power-brushing threaded studs. This holding fixture employs the "gas pipe" idea (see Fig. 2), which is both novel and scientific. The pipe is placed at a level which enables it to employ gravity as an aid in the feeding. Opposing the gravity is a small side brush which extends through the pipe opposite the brushing wheel. When the threaded stud reaches this opening and comes in contact with the power brush, it also engages the small side brush. Since the power brush rotates the threaded part, it follows the course of the threads from one end to the other and controls the time the part is in contact with the brushing surface.

If the part being brushed is made of soft material, the pipe could be of plastic or other composition. This would avoid damage to the external threads as they pass through.

Overcoming Operating Troubles

By Earl A. Dingfelder

IT SEEMS that when most plants are designed many little things are forgotten, so it is always up to the engineers who operate the plant to make improvements as I think most of us have found out.

A plant I worked in a few years ago had an oil separator to which all steam auxiliaries exhausted before going into the heating system.

Oil had been getting back to the boilers causing leaky tubes at the tube sheet and pitting of tubes and crown sheet (firetube boilers). I found that the oil separator would fill with condensate in a short time making necessary frequent blowdowns which the fireman was instructed to do every two hours, but which he generally neglected to do, no doubt thinking it not important. I decided to install an ordinary thermostatic radiator return trap in the blowdown line between the separator and sump. After changing fittings and installing the trap, we had no further trouble as condensate and oil was automatically drained. We removed the trap element once every two weeks and worked it in kerosene to remove the oil.

In this plant we also had air operated sewage ejectors which generally decided to balk at night when only the cleaning gang was in the building. Then they would quit operating, waste would back up from the sub-basement where the ejectors were located, to the basement and up through the floor drains and toilet fixtures, thus flooding classrooms and corridors.

We decided an alarm was necessary to warn when the ejectors failed to operate.

There was a U trap in the waste line in the sub basement which was about 6 ft above the ejectors and about 8 ft below the basement floor line. This was a 6 in. line. We drilled a 5/16 hole in cap of one leg of the trap through which we ran a ¼ in. brass rod to the end of which we attached an ordinary 4 in. ball float. The float was held at the correct level by a collar and set screw slipped over the float rod and resting on top of the trap cap. We adjusted the float so it would be just out of the normal flow of waste. Directly in line and above the float rod we mounted a spring button switch which would close a low voltage circuit to bells which we installed in the elevator shafts on each side of the building.

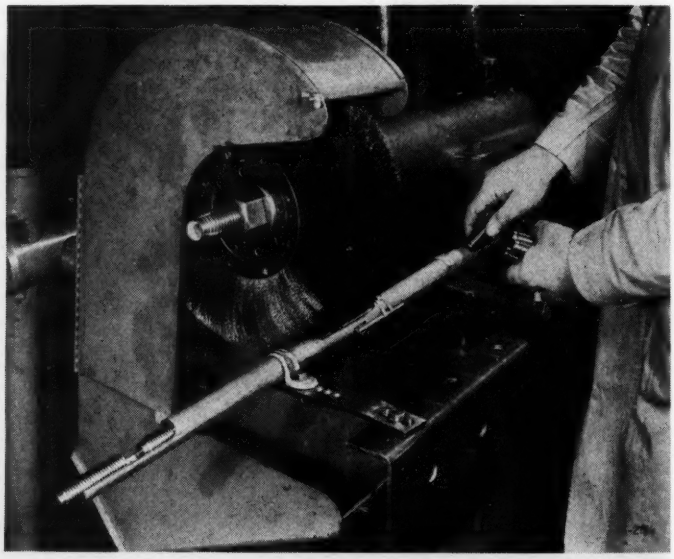
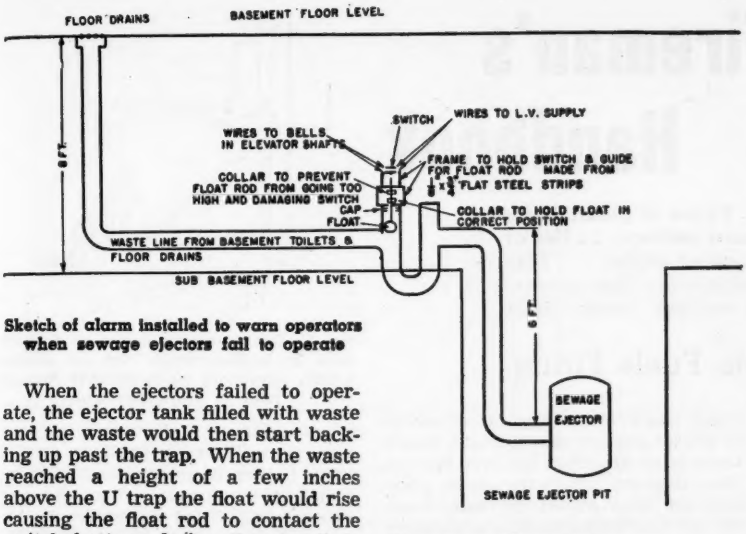


Fig. 1. (Left) Holding small metal parts with shop-made forceps. (Photo, courtesy Osborn)
Fig. 2. (Above) Adapting the "gas-pipe" to an engineered idea of holding parts for brushing

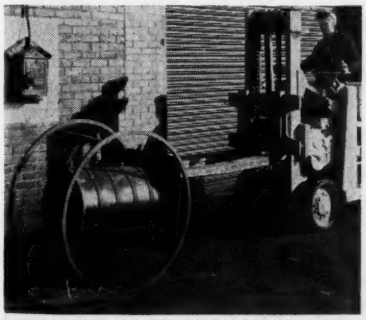

FLOOR DRAINS
BASEMENT FLOOR LEVEL
WIRES TO BELLS IN ELEVATOR SHAFTS
SWITCH
WIRES TO L.V. SUPPLY
FRAME TO HOLD SWITCH & GUIDE FOR FLOAT ROD MADE FROM 1/8 X 1 1/4 FLAT STEEL STRIPS
COLLAR TO PREVENT FLOAT ROD FROM GOING TOO HIGH AND DAMAGING SWITCH
CAP
FLOAT
COLLAR TO HOLD FLOAT IN CORRECT POSITION
6 FT.
WASTE LINE FROM BASEMENT TOILETS & FLOOR DRAINS
SUB BASEMENT FLOOR LEVEL
6 FT.
SEWAGE EJECTOR
SEWAGE EJECTOR PIT

Sketch of alarm installed to warn operators when sewage ejectors fail to operate

When the ejectors failed to operate, the ejector tank filled with waste and the waste would then start backing up past the trap. When the waste reached a height of a few inches above the U trap the float would rise causing the float rod to contact the switch button, closing the circuit to the bells in the elevator shafts which could be heard in any part of the building. The ejectors could then be tripped by hand and then the air valves could be removed and the trouble located. This plant had been operating twelve years before we installed these two simple devices and they saved many man hours in cleaning up a mess.

Roll-Over Drum Disposal

FLOYD BLIVEN, Salvage Supervisor at General Electric's Erie Works, developed this roll-over drum which easily disposes of wet grinding sludge, and similar waste. An open-top drum welded to a metal base plate is framed with two metal hoops, held rigid by angle-iron braces. The drum is easily transported by means of an electric fork truck from various machines to the drain. After lowering the drum to the ground, the operator moves the truck back until the fork tips are under the edge of the base plate. As the forks are slowly raised, the drum rolls over and the waste is emptied. The drum is automatically returned to an upright position by the weight of its base.



Roll-over drum makes disposal of contents easy

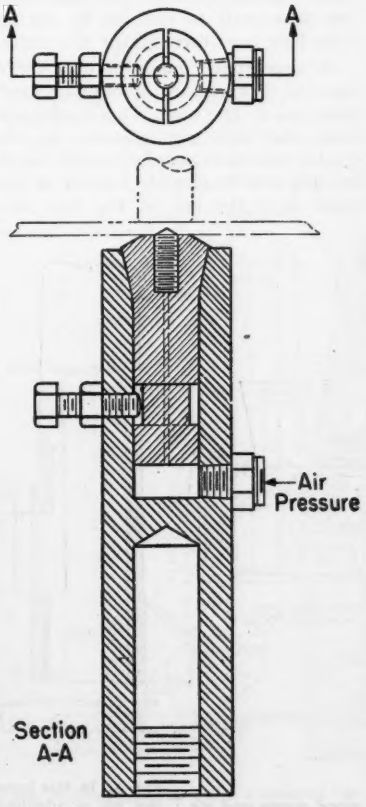
Device Improves Projection Welding

A DEVICE WHICH makes practically fool-proof the projection welding of steel studs on metal hinges and sheet metal surfaces has been perfected by Andrew Campriello, a foreman and spot welding expert at General Electric's Schenectady Works.

The device calls for a vertically-milled slot in the collet, which is located in the bottom electrode. The collet is tapered. When the stud is introduced in the collet and the upper electrode is depressed, the jaws of the collet close tightly about the stud. The resulting pressure causes the current to be distributed evenly on all sides, and at the top of the stud near the welding zone rather than through the entire stud and then to the sheet.

Below the collet is a space for air, forced in under pressure by a hose. As soon as the welding is complete and the upper electrode lifted, the air pressure forces the tapered collet upward. The collet expands and releases the stud. "Binding" of the stud on release was formerly a problem.

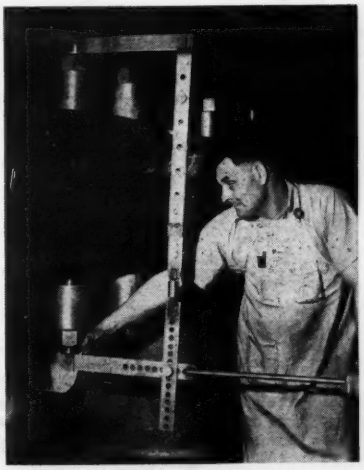
When the collet reaches a height sufficient to release the stud, its movement is stopped by a setscrew which engages the bottom of the collet.



Electrode for projection weld studs

Makes Assembly Easier and Safer

TIGHTENING or removing large nuts underneath flanges of heavy apparatus was a difficult and sometimes dangerous job until this device was suggested and developed by Samuel Solini, a machinist in General Electric's Schenectady Works turbine shop. Some of the nuts weigh as much as 75 lb.



Scheme for tightening or removing large nuts

Previously a crane had to be used, but the nuts could not always be held securely and a workman might have one fall on this toes. Solini's device, for which he received a $75 award through the Company's suggestion system, is hooked in the center of the nut on the top side of the flange. Length of the vertical bar and the reach of the lever arm is adjusted according to size of the flange by setting two pins in the proper holes. The coupling in the vertical bar permits 360-degree rotation of the lower portion of the device. The plate on which the nut is placed at the end of the lever arm is on a pivot so that it turns with the nut. A wrench can be held in position on the nut by the lever arm for tightening by sledging.

The Boiler Fireman's Handbook

By J. R. DARNELL

Types of waste fuels . . . Types of plants burning waste fuels . . . Furnace settings . . . Use of Dutch ovens . . . Water cooled grates . . . Factors for proper combustion . . . Use of preheated air in burning various waste fuels

Part XXI. Waste Fuels Firing

WASTE FUELS, for the most part, consist of sawdust, shavings, planing mill trimmings, slabs of bark from saw mills which may or may not be "hogged," tan bark and bagasse. The latter is the refuse from the grinding of sugar cane.

There are relatively few data on the burning of such waste fuels as compared to the firing of other fuels such as coal, oil and gas. In the Northwest there are several large power stations burning wood waste but of the total number of plants burning such fuels, the great majority are found in small, industrial plants such as furniture factories and planing mills.

Many small plants burning sawdust, shavings and other forms of wood waste are the worst offenders in smoke production, especially where there is no provision for over-fire air. Even in plants where the smoke problem has been solved, in many cases fly ash and cinders create a nuisance if not an actual hazard unless special steps are taken to overcome such difficulty.

Many furniture manufacturing plants having the most up-to-date equipment for the actual production of furniture, have woefully inefficient furnaces and boilers fired with wood waste. Conditions are the worst where hrt boilers, generally with low settings, are installed. Low set water tube boilers also will cause trouble, particularly with installations where all of the air for combustion is admitted through the ash pit doors and the fires must be cleaned by raking with long hoes through the fire doors.

In wood fuels containing bark there usually is a certain amount of sand adhering to the bark. This sand fuses with the ash and adheres to the grates unless hollow bars with water cooling are employed. Fusion of the sand with the ash in the fuel also causes glazing and running of the furnace walls with spalling at the joints if high temperatures are maintained in the furnace. The best and safest remedy for excessive refractory maintenance is the substitution of water-cooled walls but good results also may be obtained by enlargement of the secondary combustion space.

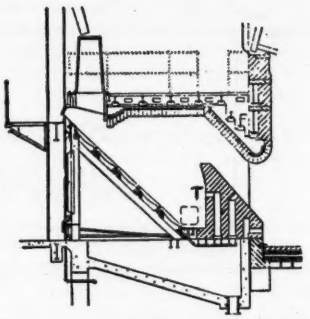


Fig. 3. This shows the design of a Dutch oven for burning waste fuels on sloping grates. Secondary air is admitted through ports in the bridge wall

Types of Furnace Settings

In some of the older installations of hrt boilers there are openings on both sides of the shell just back of the front wall, through which the wood waste is poured down on the grates. The fuel piles up against the side walls and prevents the radiation of heat from these walls to the fuel bed. To overcome such difficulty, designers have provided an extension of the furnace in the form of a Dutch oven as shown in Fig. 1. Fuel is fed to the grates in the primary combustion zone through ports in the arch forming the roof of the Dutch oven. Particles which blow over the bridge wall settle on the grate G. Secondary combustion air is supplied through openings in the rear of the first bridge wall.

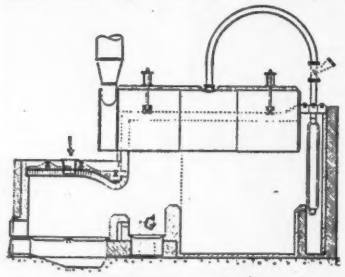


Fig. 1. This HRT boiler has a Dutch oven used for the primary combustion zone when burning wood waste on horizontal grates

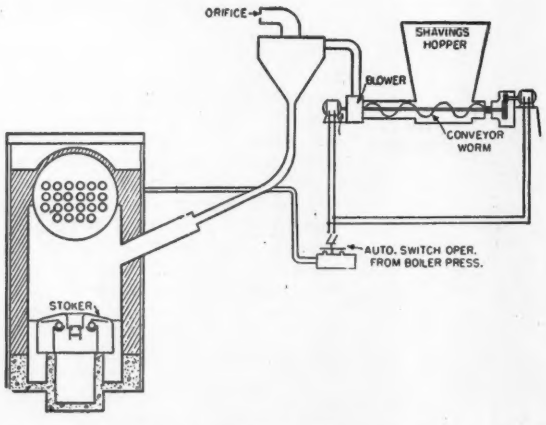


Fig. 2. In this HRT boiler setting the flow of wood waste and air through the side wall is automatically controlled

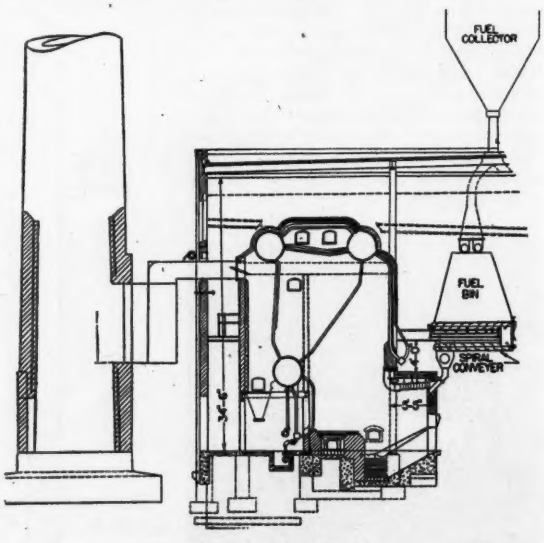


Fig. 4. In this furnace designed for burning waste fuels, secondary air is admitted through a supplementary grate back of the bridge wall

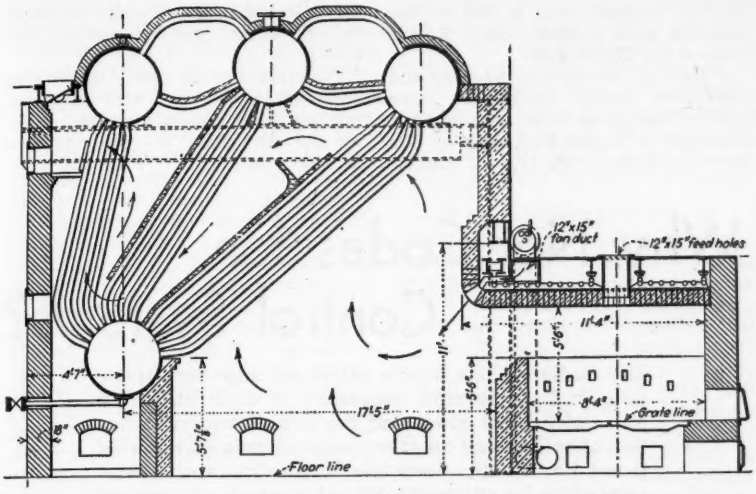


Fig. 5. Secondary air to insure smokeless combustion of wood waste in this furnace is supplied through ports in the nose of the arch forming the roof of the Dutch oven

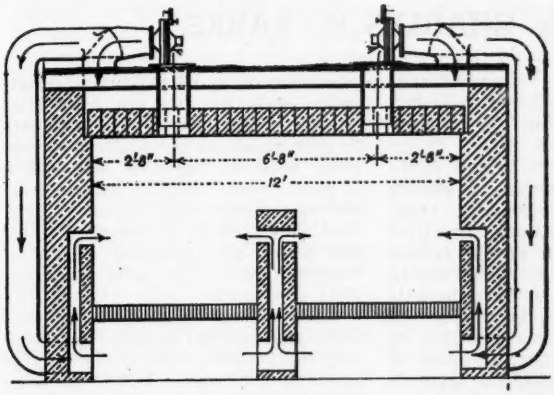


Fig. 6. This is a sectional front elevation of the Dutch oven of Fig. 5. Primary air discharged horizontally through the side walls and outer pier prevents the air from lifting the fuel from the grate

In one plant with a low set hrt boiler the problem of burning sawdust and shavings without smoke has been solved by automatic regulation of the amount of fuel and air fed to the furnace. As shown in Fig. 2, fuel is fed by a worm conveyor to a blower which discharges to a cyclone separator. The conveyor and the blower are both connected to an automatic switch actuated by steam pressure. Since smokeless combustion of the wood waste depends on the correct amount of air and fuel fed to the furnace, an orifice has been inserted in the separator vent to control the amount of air released to the atmosphere. With such arrangement the sawdust and shavings are burned in suspension.

In Fig. 3 is shown a Dutch oven arrangement with step grates which may be used with any kind of boiler although it has been found that boilers of the bent tube type with the tubes arranged almost vertically, give the best results when firing waste fuels. There is greater combustion space and less likelihood of accumulation of fly ash on the tube surfaces.

Figure 4 shows such a boiler with a Dutch oven and inclined grates for primary combustion. Secondary air is admitted through grates back of the bridge wall. These grates are overlaid by brick checker work. There is a total of about 109 sq ft of fuel burning area with 1896 cu ft total furnace volume. The boiler has 5900 sq ft of heating surface and is designed to produce approximately 50,000 lb steam per hour at 200 psig.

One of the most effective furnace designs for burning wood waste is shown in Figs. 5 and 6. Figure 5 shows a longitudinal sectional elevation through the furnace in which combustion is effected in two stages. In the first stage the fuel is fed through the top of a Dutch oven where it falls into horizontal grates. This part of the furnace acts as a gas producer. The gas evolved from the fuel is then burned in the enlarged section of the furnace beyond the bridge wall. Secondary air for complete combustion is supplied through parts in the nose of the arch.

Figure 6 shows a front sectional elevation of the Dutch oven and grates. Primary air for the fuel is supplied by turbine driven blowers mounted on top of the dutch oven. This air passes through the side walls and through the center pier. By such arrangement the air is forced horizontally into the fuel bed instead of vertically and this prevents the fuel from being lifted off the grates and carried into the secondary combustion chamber. This boiler has operated at about 260 per cent of rating without any smoke or cinder accumulation.

Proper Combustion Depends on Furnace Volume

In any furnace burning wood waste the total sq ft of fuel burning area has less significance than the total cubic feet of furnace volume since a considerable portion of the fuel is burned in suspension. The most significant factor is the ratio of fuel burned per hour to the cubic feet of furnace volume.

In the operation of the boiler shown in Fig. 4 when producing 50,000 lb steam per hour at 63 per cent effi-

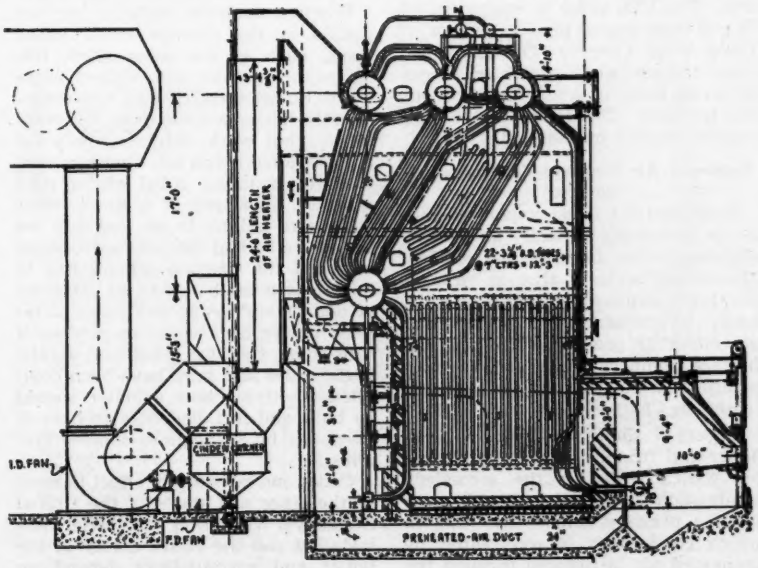


Fig. 7. Water cooled walls, preheated air and a cinder catcher are provided for burning hogged fuel in this 550 hp Stirling boiler setting

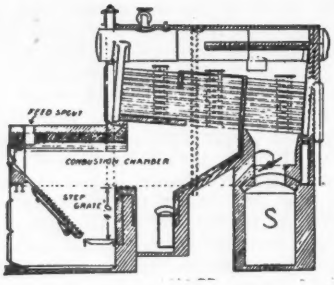


Fig. 8. Bagasse is burned on step grates in this furnace

ciency, if we refer to Table V in Chapter VII we find that if the fuel has a heating value of 4940 Btu per pound as fired, the pounds of fuel per bhp will be:

$$\text{Lb fuel per bhp} = \frac{33{,}500}{4940 \times 0.63} = 10.75$$

Assuming 30 lb steam per bhp, at a load of 50,000 lb steam per hour, the total horse power will be 1667 and the total fuel burned will be 1667 x 10.75 = 17,920 lb per hr.

The ratio of fuel burned per hour to the furnace volume, therefore, will be

$$\frac{17{,}920}{1896} = 9.5 \text{ lb fuel per cu ft furnace volume.}$$

Since wood waste fuels average about 20 lb per cu ft, the above figures indicate that furnaces should be designed to burn not more than ½ cu ft of fuel per cu ft of furnace volume if the moisture content is in the range of 40 to 50 per cent.

Referring to Fig. 5 in Chapter VII, if the flue gas temperature is 500 F, the CO_2 will be about 13.8 per cent when the overall efficiency is 63 per cent. This CO_2 value is equivalent to 49 per cent excess air. As shown in Table V in Chapter VII, the maximum theoretical CO_2 with no excess air when burning wood fuel is about 20.5 per cent. This is due to the high oxygen content of the fuel.

Preheated Air Increases Efficiency and Capacity

Preheated air is an important factor in increasing capacity as well as efficiency when burning waste fuels. This is particularly true in view of the high moisture content of such fuels. Types of air preheaters and the effect of preheated air on CO_2, furnace temperature, flue gas temperature and overall efficiency is discussed in Chapter VIII.

Figure 7 shows a 550 hp Stirling boiler and furnace provided with water cooled walls in the secondary combustion zone and a Dutch oven for the primary combustion zone in which combustion is accelerated by preheated air introduced through the grate bars. A cinder catcher is provided at the bottom of the air preheater. Hogged fuel is fed to the primary zone through ports in the roof of the Dutch oven.

Furnaces for burning bagasse and tan bark usually follow the same general design as those for saw dust, shavings or hogged fuel. In Fig. 8 is shown a Dutch oven type of furnace for burning bagasse under a longitudinal drum type of water tube boiler.

In a number of cases, waste fuel furnaces are provided with oil or gas burners for stand-by purposes. Stokers for coal firing are also installed as shown in Fig. 2.

Why Not Codes for Control Systems?

The author of this article raises an important question. If it is deemed necessary to draft elaborate and rigid codes governing the design and construction of boilers and other pressure vessels why should it not be equally desirable to provide such codes governing the automatic control apparatus by means of which boilers and related equipment are operated

By CHARLES W. PARKS

THE ARTICLE in the December issue entitled "When boilers overheat" which was taken from the Locomotive, by the Harford Steam Boiler Ins. and Inspection Co. is well worth taking into consideration by owners and operators of automatic, unattended boiler installations. In all of the cases cited in the article, failure was due to low water, which was in turn due to failure of the automatic control to start a pump or stop the burner. These failures are due in turn to lack of proper attention to the controls or inadequate controls being supplied. In many instances, only one float and switch is installed and when this fails, there is nothing to fall back on, which results in burning up a boiler, with its disastrous results.

When automatic controls are installed in the average small boiler room, such as the cases cited, this leaves the operator with little or nothing to do after starting up and consequently he is sent out into the plant to do other work, returning only for an occasional check up. One just such case comes to my mind where, only recently, an owner of a small boiler room was talking to me and told me that since he had the automatic pump installed the fireman seldom has to bother with the boiler at all. Millions of dollars and years and years of research have been spent to produce a safe boiler steel for tubes and sheets. Rigid codes and laws have been compiled specifying how a boiler should be built and installed only to have it burnt up by inadequate control systems.

Codes and laws are in effect in most of the cities and states of the United States, yet with all of this, boilers are installed and the entire safety of the boiler and surroundings depend on one or two little floats or switches. Why is this? If we can have laws governing the construction and installation of boilers, we can have laws to compel the proper and adequate protection where the boiler is to operate most of the time unattended. If plant owners want to operate their boilers automatically and unattended, then they should be compelled to instal a full and adequate system of controls to assure the safety of everybody concerned.

There should be adequate cut-outs and signal systems installed and properly maintained. This is not only of profit to the owners but is no more than fair to the men and women that work in or around the boiler room, considering the disastrous result of an explosion. If, where no such laws exist, a safety program should be drawn up and distributed to these operators and owners to educate them and point out the best operating policy from a standpoint of safety. This program should consist of a set of specifications and instructions stating just how many and what kinds of controls to install and how to maintain them. Above all, the program should contain a preventative maintenance schedule, to assure that the controls are properly maintained. An example of such a program, according to my way of thinking and how I would like to see it drawn up, is presented here. This program consists of three parts. The first part covers the installation of automatic controls. Just how many and what kind and how they are to be put in. The second part deals with the maintenance of such controls. The third part describes the purpose and operation of such controls.

Part I

On fully automatic boilers, that are to operate unattended for any period of time, two feedpumps should be provided. There should be two complete sets of controls provided. One

pump is to run continuously under action of a pressure governor, set to maintain from 30 lb to 40 lb feedline pressure above the steam pressure. The water is to be fed to the boiler by means of a feed water regulator (level). The other pump to be used as a stand-by. This pump to be connected to a pressure cut-in switch under action of the feedline pressure, to start the pump in event of feedline pressure failure. These pumps are to be interchangeable so that either pump can be set to run continuously or to be used as a standby.

Two signal alarms should be installed. One signal is to be connected to a pressure switch so that a failure of the feedline pressure will actuate the alarm and at the same time stop the burner. The other signal is to be a low water level alarm to operate in event of low water. This alarm, on coming into action, opens the burner circuit also, in event of failure of the pressure alarm. In case of electric pumps and signals, there should be no other equipment on this circuit. In the case of steam driven pumps, there should be no other equipment on this steam line. In case of pneumatic equipment, this should have its own individual compressor or an emergency unit set to cut in, in event of air pressure failure.

Signals should be loud and clear, located so that it can be heard at any point on the company's premises and of such character that they cannot be mistaken for some other signal. These signals to be so arranged that they cannot be shut off except by restoring water level or feedline pressure. These signals to take their source of current from the main shut-off switch for the burner, so that when the boiler is shut down, the signals will not operate. A high water level alarm can be installed to work in conjunction with the low water alarm.

Part II—Preventative Maintenance Schedule

After every thirty days of operation, the safety equipment should be thoroughly gone over and tested. Repairs and adjustments being made where necessary. These inspections and repairs should be properly recorded for reference.

The governors, diaphragms, valves and pumps packed where needed. The pressure switches, contacts and electrical connections checked. Pump and motor bearings checked and lubricated properly. Low water level float chamber and switch to be inspected. Every day when the boiler is shut down, it should be done by first shutting off the feedpump and allowing the pressure switch to start the other pump. Then both pumps to be shut down and allowing the signal to sound and shut off the burner. This assures that the protective equipment is in perfect operating order. As often as possible, preferably once each week, the feedwater valve to be shut off and allow the water level to drop and sound its alarm and stop the burner. After which the valve can be opened and the water brought back up to proper level. The boiler inspectors should take an interest in this work and require a monthly report of the inspections and allow no major repairs to be made without his permission. All inspections should be made by a licensed engineer or competent person.

Part III—Operation and Purpose

If the pump that is running continuously, stops, the feedline pressure will drop, thereby actuating the pressure switch to the other pump, starting it and restoring the pressure. If the other pump fails to start, or the water supply has failed, the pressure switch to the alarm will come into action, sounding the alarm and stopping the burner. When the second pump starts up, there will be about ¾ of a glass of water still in the boiler. When the pressure alarm sounds, there will be from ½ to ¾ glass of water. The low water level alarm is for the purpose of sounding an alarm and stopping the burner when or if the other devices fail to operate. The purpose of each set of controls having its own source of power is to minimize the possibility of some one drawing the power, thereby rendering the controls inoperative. The reason for the reports and inspections is to insure that the controls are always in operating condition. The purpose of the reports to the inspector is to have someone checking up on the work to see that it is carried out in the proper manner.

To some people, the above program will no doubt be considered elaborate and unnecessary. It is surprising to know how many people who have owned or operated boiler plants all or most of their lives and yet do not know how much power or energy is stored up in their little, seemingly harmless boilers. Only one who has witnessed or saw the results of an explosion can have any conception of this power. Any program or law that will prevent or even cut down the boiler accidents, is well worth having and if the above program is adopted I feel sure that progress towards this end will be made.

DURING WORLD WAR I an average of nearly 3½ lb of coal was required to produce a kilowatt hour of electricity. In 1944 less than 1⅛ lb were required.

"Now, look, Mortimer, the management frowns on this sort of commercialism despite your offer of cutting us in on the profits!"

SHOP EXPERIENCE IN THE MIDDLE EAST

By J. C. DeFoe

Those who read the Practical Engineer & Electrician section before 1943 may remember the author of this article as a frequent contributor to these pages before the war. Quite often he wrote under the pen name of Atomizer John. In this issue Mr. DeFoe comes back to these pages after 3½ years in the army and we believe that his article dealing with his service overseas will be of interest to every reader of Power Plant Engineering. In his first letter to us Mr. DeFoe writes, "You will find enclosed a poor effort in an attempt to start writing articles again. Forty-one months in the Army have sharpened my experiences but dulled my pen.

"Thirty-seven of the forty-one months were spent overseas with an engineer heavy shop and an ordnance base shop. Eighteen months were spent operating shops under British supervision in the Middle East and nineteen months of service with ordnance base shops in the United Kingdom and Europe.

"Since leaving continental U. S. in October 1942, travels have carried me to Rio de Janeiro, Brazil; Durban, Union of S. A., Indian Ocean, Red Sea, Egypt, Palestine, Syria, Iraq, Arabia, through the Suez Canal and Mediterranean Sea, past Gibraltar, Scotland, England, France, Belgium, and Luxembourg. Re-entered the greatest country in the world 29 October 1945.

"Have handled skilled Arabs, Jews, Egyptians, European refugees, British soldiers, German prisoners of war and American soldiers in shops; there's no one like our grand American boys on mechanical work, or anything else as far as that goes.

"Thanks to the leadership of our American soldiers—Arabs, Jews and European refugees worked together under their supervision for ten months and not one unpleasant incident took place in that time.

"I am glad to be back with my old company, they have certainly treated returning service men swell and are really giving us breaks in jobs."

AT THE PRESENT time newspapers and radios are carrying much news about economic and political developments in the Middle East. So long as the news searchlight is focused on this troubled area the readers of POWER PLANT ENGINEERING may be interested in learning a little more about the peoples populating these countries on the "other side," especially if the contacts were made by virtue of Engineer Shop operations in the place which is now the center of the present troubled region.

The outstanding experience of dealing with these peoples was enjoyed while supervising a complete engineer heavy shop in Palestine. Incidentally this was the largest American shop installation outside of Egypt in the Middle East. The shops were used to repair heavy earth moving equipment (bulldozers, cranes, tractors, etc.) and were made up of the following facilities: 20 lathes, 3 milling machines, 3 shapers, horizontal boring and table miller, crankshaft grinders, 14 welding machines, electrical and rewind section, 1½-ton an hour cast-iron foundry, non-ferrous crucible furnaces, blacksmith and heat treating shop, pattern shop, 6 mould vulcanizing and tire repair section and an enormous repair and engine rebuild shop. Altogether it involved two hundred and thirty tons of shop equipment and tools. All operating supplies were drawn through British depots.

From start to finish the shops and operating personnel were like a phantasy of universal blends of men and machines. The foundry moulding sands came from an abandoned Arabic cemetery (teeth and bones were mute evidence), the American made cupola was fed with Turkish pig iron, scrap from British vehicles and coke from England. Arabic and English moulders used patterns made by German and French Jewish refugees, the castings were finished by machinists from Palestine, Europe and the British Empire. Finally the parts were installed on American equipment lend-leased to our British Allies. The shop personnel was made-up of 12 great U. S. Army enlisted men, 17 British soldiers, 250 civilians which included Jewish refugees from every European country (with exception of Norway, Sweden, Portugal, Switzerland and Luxembourg), natives of the Middle East and American Jews residing in Palestine.

The 12 U. S. enlisted men chosen to run the shops were probably the most select group of shop men in the Corps of Engineers. Every man qualified for his job by years of experience in the same type of work performed in civilian occupations. The British Military personnel was hand-picked from the ranks of Royal Engineers and Royal Electrical and Mechanical Engineers —a grand group of Scots, South Africans, English and Irish. Even among the Americans there was quite a mixture of bloods, a ¾ American Indian, a Dutch born machinist, a German born foundry man, 3 Missourians and the rest also good American stock.

Skilled craftsmen among the civilians, especially the European refugees proved an invaluable reservoir of shop talent. Welders proved to be a problem until the British furnished soldiers and a few trained civilians who had electric welding experience, gas welders and cutters were found among the Palestinian personnel. Pattern makers came from the Jewish group, foundry men and blacksmiths were all Arabs, and the outstanding machinists beside the American soldiers were the German refugees.

The question of language differences did not prove as difficult as the reader might imagine; the ability of most Europeans and all Middle Easterners to quickly absorb a working knowledge of the English language eventually proved to be an unparalleled benefit, also many of the civilians had studied English, this automatically became an advantage in shop operation, but the indispensable interpreters were a German educated Pole who had spent 20 years in the Middle East and spoke 7 languages and a 14 year old Arab boy who could read and write Arabic while carrying on a three way conversation in English, Hebrew and Arabic tongues.

The simplicity of operating designs on American shop equipment was certainly exemplified by the rapidity with which the cosmopolitan personnel learned its operation. Irrespective of the praise and desire the civilians had for American machines and tools there were some they never fully accepted. It was next to impossible, even after demonstration to get a machinist to use a clock gage or test indicator, for turning a piece of work in a lathe, they preferred, almost without exception, the scribe held in a surface-gage. When sawing wood the American hand saw is regarded as something hot by the natives, who prefer a saw which has the appearance of our buck saw—it does the job though.

American, British, Refugees, Arabs, Palestinian Jews and nondescripts all worked together in perfect harmony for 10 months, yet during all that time there seemed to be a question uppermost in the civilian minds, and that was: "Why are Americans always in such a hurry?"

Corrosion of Economizer

By John F. Slavinsky

RECENTLY OUR economizer sprang a leak at the gasket on one of the return tube ends. After making repairs by replacing the defective gaskets with a new metallic gasket, we inspected the old metallic gasket through a magnifying glass and much to our surprise found that the gasket failed due to a bad oxygen corrosion condition in the economizer tubes.

The gasket being of much thinner metal naturally was the first part of the economizer to show signs of oxygen corrosion.

This economizer was installed and put into service in the fall of 1941, and our next concern was for the economizer itself.

As we use the most modern feedwater treatment available at this time, and have one of the latest designed feedwater heaters of the deaeration type, we were more or less in a quandary as to the cause of this condition.

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Fig. 2125 Bronze Gate

Fig. 1640 "King Clip" Gate

Fig. 1938 Steel Gate

Fig. 1430 Iron Body Gate

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After making a thorough survey of our operating conditions we came to the conclusion that when the plant was in operation 24 hours per day this condition did not exist, but when the plant was shut down and the boiler was operated with a banked fire over the week end shut-down period there was not enough exhaust steam discharged from the duplex feed pump to maintain exhaust steam pressure to keep the deaerating heater operating efficiently.

To remedy this condition we were advised by the service engineer to install a steam line to the heater with a reducing valve set to introduce about 5 psi steam into the heater over the week end when plant was not in operation, to maintain the same conditions in the heater, as when the plant was in operation at full load.

Step number 2 was to continue pumping sodium sulphite into the feed-pump suction, which we did not do before when plant was shut down. Sodium sulphite eliminates some of the oxygen in the feedwater by combining it to form sodium sulphate.

To maintain the concentration of sodium sulphite at the recommended limit we used 4 lb over a 24 hr period for the 2 day shut-down. With the continuous blow-down line of the boiler partly open the concentration can be kept under control within the recommended limits.

We believe that with the above mentioned controls we can eliminate the oxygen from our economizer over the week end shut down period.

LETTERS AND COMMENTS

Acid on Cement Floors

IN THE JANUARY issue I noted a request for help at a factory that has been having trouble with the cement used for tiles on floors. We have floors which have to stand up under acetic acid at high concentrations as well as low concentrations. We have found that Tegul Vitrobond made by the Atlas Mineral Products Co. of Mertztown, Pa., is very satisfactory. I hope this information will be of help to your reader.

F. A. LOBLEY,
Chief Engineer,
Miles Laboratories, Inc.
Elkhart, Ind.

Pump Lining Trouble

A WHILE BACK one of the boiler feed pumps in the plant failed. The fireman called the operating engineer to investigate. The trouble was located in the water end of the pump. After the pump was opened, it was discovered that the brass sleeve had become loose from its setting. Further investigation disclosed that the piston body projection was badly distorted. The piston body was removed, and sent to the shop to be aligned. After it was returned to the plant, the engineer in charge put the lining to proper setting, and the pump was put back in service.

The following day the same thing occurred with another fireman on duty. He called the engineer in charge on this shift. Investigation revealed the lining to be out of setting and the piston body projection distorted. The same procedure was followed—pump piston body projection was aligned, pump put back in working order by our chief engineer and a machinist. To date the pump is still working.

At the suggestion of my chief engineer, I am writing this pump episode. Thus far it has not been stated what caused the lining of the pump to be removed from the proper setting. Here is what the writer related to his chief as to what he thought was the trouble. A badly worn lining along with rock hard packing that was butting. The writer knows as the old timers read this they will have to admit that packing that is butting will cause plenty of trouble.

To speedily find the cause of the trouble at hand, pool your knowledge with your fellow-worker as he may have a better knowledge of it than you do at the time. Every day brings new enlightenment to all of us because someone is willing to share that which he received from another. Keep in mind that none of us has anything but what has been received from another. Pretense without real knowledge is folly in the engineer's world. Hey! I'm off the pump subject, so I'll sign off. Oh yes, and for the one who might have all the knowledge—what's a cuddle valve?

SAMUEL J. AYLING.

Wire Brace in Electrician's Cap Causes Short

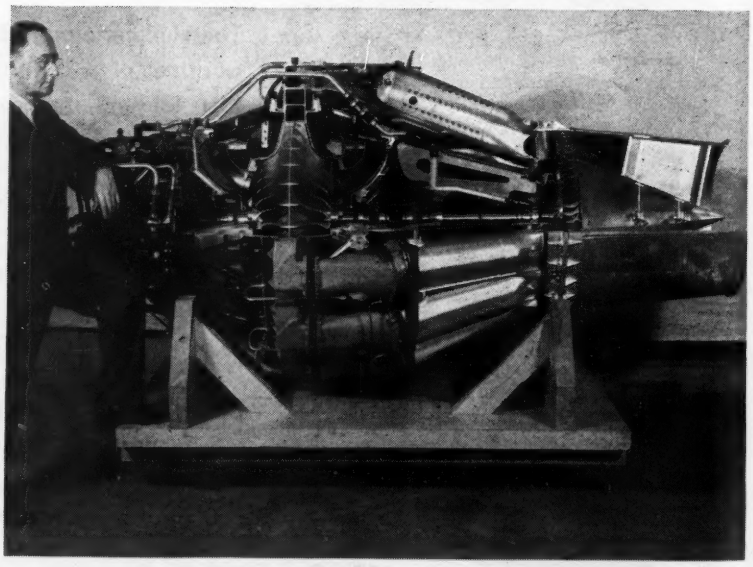
RECENTLY we had an accident befall our plant electrician and I thought I would pass this information along to other readers so that they may be on their guard and benefit by this rather unusual and painful mishap.

The plant electrician was working on the live a-c switchboard drilling some holes into a copper ground bar so that it could be anchored on the switchboard legs. The insurance company wanted our 480 v a-c board panels grounded.

While he was working at the switchboard we heard a terrific explosion and saw a flash. The next thing we saw was a mass of flames around his head, face and shoulders.

One of the watch engineers ran over to the man and jerked his hat off and smothered out the flaming clothing.

Although the man was painfully injured, spending over a week in the hospital, fortunately his eyesight was



This Is the Jet that Shoots the Stars

SHOWN ABOVE IS a cut-away of General Electric's jet engine of the I-40 type which recently drove the Lockheed Shooting Star on its California-to-New York speed record of 4 hr and 13 min. The exposed heart of this light and simple engine, which produces 4200 lb of thrust, shows the broad compressor blades connected by shaft with the turbine. These units rotate together, forming the single moving part of the engine

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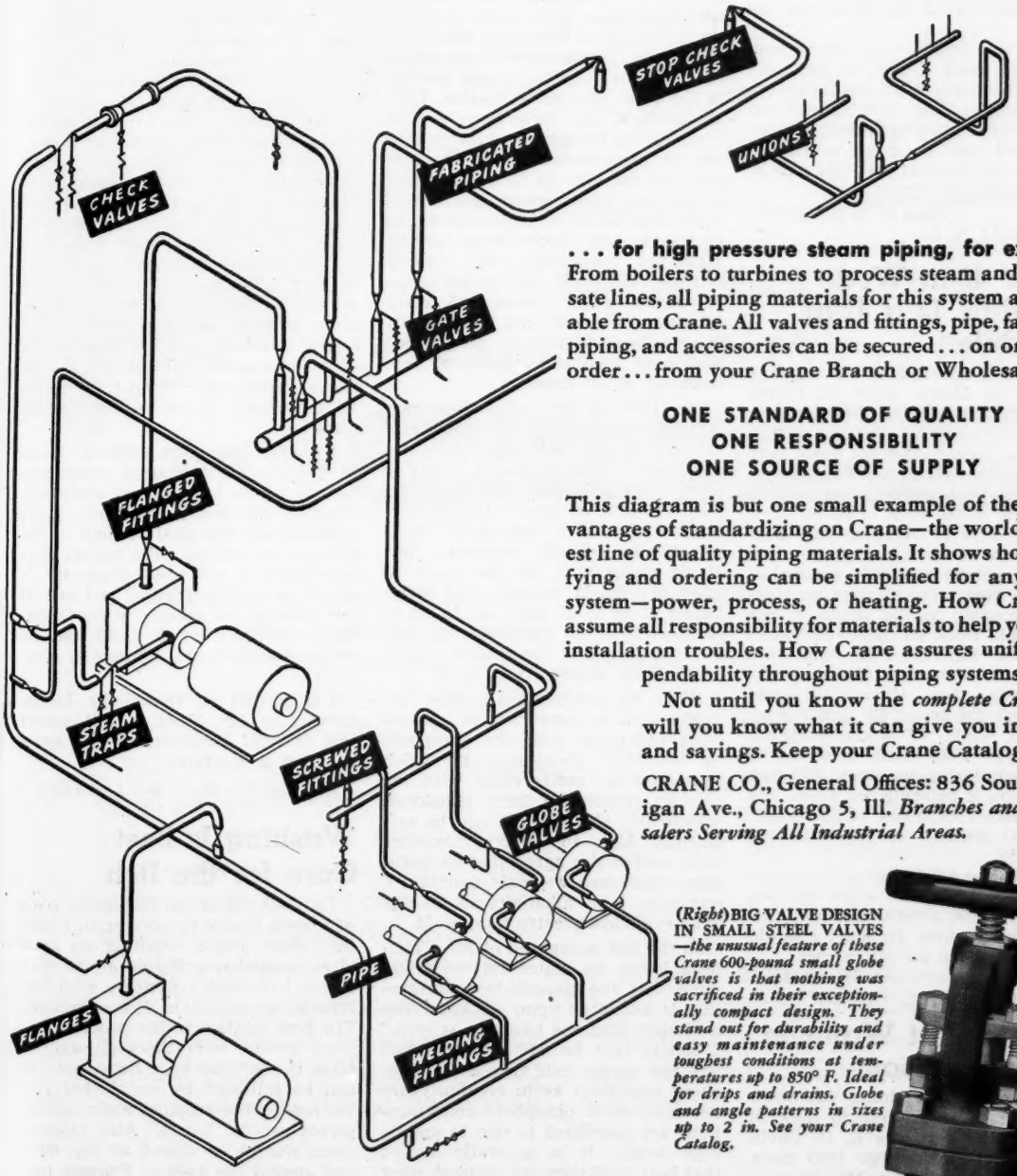

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unimpaired. After making a study of the accident we found that it was due to a cap with a celluloid peak and a wire brace at the peak that was the cause of it all. This cap he was wearing is the kind that has a celluloid peak with a wire running from one side of the crown to the other side. While working at the switchboard the peak of his cap touched an open 3-phase knife switch and hence the explosion.

Since this accident no one is permitted to wear a cap of this sort around the power plant and as an extra precaution from now on any one working near open knife switches on the board has to drape a rubber blanket over them so that this type of accident will not repeat itself.

JOHN F. SLAVINSKY.
Ridgefield, N. J.

Parks' 40-hr Work Schedule Is a 42-hr Schedule

The work schedule shown on page 106 of the March issue of POWER PLANT ENGINEERING, appears to be in error.

It is a 5-day, 40-hour week only insofar as the working of five days in succession is concerned—not according to the usual week of seven days. In these days of overtime pay after forty hours of work in any one week it would not be generally applicable.

If the week were to start on Monday, according to the schedule, one man would work six days (48 hours) each week. Further, if the week were to start on Thursday (for example, March 28th), then "A" and "D" would each work six days, "B" would work five days, while "C" would work but four days. Four men, working 40 hours each during one week, will lack eight hours of finishing the week. The total number of hours worked, 160; the total number of hours in one week, 168.

It falls my lot to be on the 11:00 P.M. - 7:00 A.M. shift, which explains my interest in a rotating 5-day, 40-hr. work schedule. In short I would like to see if the sun still shines.

Mason City, Ia. GLEN R. LYTLE.
Box 81.

How to Test Water in the Boiler Room

EVERYTHING pertaining to water treatment is of interest to me. Of particular interest was E. O. Davis' article in the November 1945 issue. The commentary from Mr. Fleming and Mr. Davis' reply in the February 1946 issue tend to bring out much-needed discussion of important controversial ideas.

I question very much the statement by Mr. Davis that boiler water should be kept between 0.1 gr and 0.5 gr hardness. I do not doubt that there have been instances where boilers have been kept free from objectionable scale under such conditions. However, in such cases it is likely that certain existent conditions made such trouble-free operation possible.

The ratings may have been relatively low. The same may be said of the operating pressure. In fact, it has only been in recent years that phosphate conditioning has been advocated for pressures under 150 psi. Blowdown may have been high, or the boiler design may have influenced the results. It may be that coagulants absorbed the deposits or were present in the form of organic matter. Then again there may have been periods when excess phosphates were present and the small amount of deposits were removed thereby. In fact, if little or no calcium were present, the magnesium salts would be converted to the hydroxide by maintaining proper alkalinity conditions. Any number of things may have contributed to the prevention of the objectionable scale. Whatever the conditions, there is only one really safe rule to follow and that is to keep boiler water at zero hardness at all times.

Mr. Fleming correctly states that in boiler water "that has been properly conditioned and has a (soluble) phosphate concentration of from 40 to 60 ppm phosphate (as PO_4), the hardness will be zero." Let me emphasize the term "properly conditioned" as regards alkalinity. Mr. Davis states that, at the plant in question, the M reading was maintained at 18 to 26 gpg. He failed to mention that the important element is to be sure that the P alkalinity is at all times greater than ½ M.

When the hydroxide is present, the magnesium is converted to magnesium hydroxide, and the phosphate to trisodium phosphate, in which form it will readily react with the calcium present to form tricalcium phosphate. Also, the pH will be sufficiently high to inhibit corrosion. Most authorities agree that to fulfill these conditions we must maintain a minimum total alkalinity of 10 gpg with P always greater than ½ M.

In the last paragraph of Mr. Fleming's letter, he states "if we determine that the phosphate concentration is above 40 ppm, we know immediately that the hardness is zero." I believe that he will find that this will not always hold true if the foregoing conditions as to alkalinity are not met, or if phosphate concentrations are permitted to rise to unduly high levels. It is generally agreed that best conditions are assured when the phosphate is held between 30 and 60 ppm.

I believe that the use of the term "phosphate" should be clarified somewhat by referring to it as soluble phosphate or excess phosphate, so as to not confuse it with the tri-calcium phosphate resulting from the action of the tri-sodium phosphate on the calcium salts. This latter precipitate is insoluble and must be removed by filtering before making the usual phosphate test.

I have always thought it good practice to run a soap hardness test on the boiler water as a check, particularly when proper alkalinity conditions are not maintained, or when excess phosphate concentration is unusually high.

It should not be out of place to make a suggestion as to the method of feeding phosphates. Never introduce them to the feed lines except in shots, or deposits are likely to occur. These deposits usually make themselves known through faulty operation of feedwater regulators. When phosphate is introduced in shots, it is followed up with sufficient phosphate —free water to enable the deposits to be washed out before they can become adherent. When it is desired to feed phosphate continuously, it should be fed direct to the boiler drum through a separate line. The feeder should be set as close to the drum as possible. If this small line should eventually become incrusted with deposits it can easily be replaced.

As to the use of the different types of phosphates, operating conditions dictate which is the most desirable. Whether you feed meta, mono, pyro, or di-sodium, the final product in the boiler is tri-sodium. The reason that tri-sodium is not used originally is that it is highly alkaline, and one of the reasons for phosphate conditioning is that, in using it, water may be softened without any increase in alkalinity.

I trust that my friend, Mr. Davis, as well as Mr. Fleming will accept this friendly comment in the spirit in which it is offered.

Kirkwood 22, Mo. W. J. WRIGHT

Washing Is Best Cure for the Itch

ON PAGE 105 of the December issue of POWER PLANT ENGINEERING, I note that some fitters working on spun glass insulation suffer from the itch. I have had some experience with this type of insulation in tower packing. The best solution to the problem is a good shower with thorough soaping after the job has been done and this can be followed by an alcohol rub. To reduce the trouble, wear leather gloves on the hands. Also clothing worn should be closed at the wrist and around the ankles. Friction tape serves admirably for this purpose. Keep the shirt outside the pants or wear a pair of overalls. At the end of each day blow out the clothing with air. Water-proofing overalls with aluminum stearate will also greatly reduce the penetration of the glass particles.

Hopewell, Virginia

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A Call to Arms

By Thos. W. Benson

THERE IS LITTLE doubt that we are entering an era that may be marked by many startling changes in means and methods of power generation and utilization. It naturally follows that an effective program must be set up for training operators in the use of equipment that will be going into service as post war plans materialize. The able discussion of Mr. Mosher[1] on this phase of the subject requires little elaboration, as he covered thoroughly the methods for setting up the necessary training programs. It might be added however, that in addition to industry and government sponsoring educational efforts along this line, equipment manufactures and insurance interests should also render aid and encouragement to such movements.

The purpose of these paragraphs is to consider what rewards the operating engineer is to receive in return for the higher skills he must develop to meet the changing conditions. The training of new engineers in higher skills demands that men now operating must also increase their knowledge and ability or be hopelessly lost in the flood of future developments.

Are we to assume that the operating engineer will naturally receive the proper recognition of his status in the national economy, both financially and professionally? Or will he continue to be the forgotten man, the drudgehorse that carries on without recognition or appreciation?

Based on past conditions, it is unlikely that there will be any change in the operating engineers status or condition of servitude unless long range plans action are effected to change the viewpoint of management. One need but thumb through the back issues of POWER PLANT ENGINEERING to find sufficient material to write a book on the abuses heaped on the operating engineer and the existence of such conditions is convincing proof that changes should be made. With industries' need for skilled men comes the opportunity to remedy the defects that have driven more than one man to seek other fields of endeavor.

In many criticisms leveled at management and working conditions by contributors to these columns in the past, there has been a marked absence of any suggestion for correcting the evils beyond those which might apply to isolated cases. Long range, and overall planning for the general improvement of the power engineers has been lacking, so it is with some trepidation that an outline for such a plan is developed here.

The first and major difficulty is to get a group of men altruistic enough to support any program that does not promise immediate and personal profit. Since the individual is helpless in face of existing conditions, results can only be obtained by sustained group action, so that must be the starting point of any plan that might succeed. In view of the fact that world developments in the past year have forced the individual to assume an international viewpoint on many subjects, it is possible that now for the first time in many decades there is reasonably hope that the operating engineer may realize working conditions and financial rewards comparable to those of the man in the next block.

The nucleus of the group would naturally be some existing operating engineers association, to avoid the delay and work involved in building a new national organization. Such efforts at bettering the engineers position should fall within the realm of the activities of such an organization and would require little change in organization setup or bylaws.

Any concerted action demands financing, for much of the work must be a full time occupation for active agents and the load must fall first of all on the members of the organization. This implies increased membership, in fact the membership of every engineer in the country should be aimed at and much of it could be realized if they were approached with a real, comprehensive program for concrete action that had as its direct objective the engineer's welfare, both personal and financial.

The first action of the organization should be to set up a committee that had as its first objective the preparation of an improvement program. This should cover three main fields, educational, publicity and legislative.

In the educational field it should make a study of past efforts in the training of engineers and the results, with the idea of making their finding available to all those interested in planning power engineer training. It could further set up minimum standards as to time and subjects of training programs and work out a system of certifying those who have completed such formal instruction as decided upon.

A study should be made of publicity methods that would impress the public as well as management with the importance of the engineer in industrial progress, conservation of natural resources and the general well being of the nation. This need not involve direct advertising, but a systematic effort to have equipment manufacturers so slant their advertising copy to bring the operator into the picture and indicate his part in the proper functioning and continued satisfaction that is bound to result when their equipment is under the care of properly qualified operators. Such facts can be brought out in many ways that are now neglected or ignored. Simply rephrasing an offer of free engineering service, would remind a prospect that he has an engineer in his employ who deserves consideration.

And finally the legislative or licensing phase. Here again a study should be made of licensing practices throughout all the states and recommendations worked out from past experience to form a basis for licensing procedure. Obviously some system of graded licenses would be necessary to meet all the conditions meet with in the operating field.

From such a study there could be drafted legislation that could be submitted to the legislature of the various states in a real attempt to make them all uniform.

The enactment of such legislation need not affect the men at present holding positions. Should a graded system of licensing be found desirable it would not be difficult to work out an equitable method of rating operating engineers now employed, on the basis of their experience and position and to issue licenses in the proper classification.

It is realized that no small group of men could carry out this program. It's first activities would be confined to developing the details of a workable program This would require at least a year to gather the information required, to study and analyse it and draft up to recommendations. With this material in shape there would be possibility of putting on a membership drive that would result in an imposing organization that could finance a nationwide drive for the proper recognition of the power engineers.

The actual work of carrying out the program would then fall on smaller groups located in the individual states or centers of industry, which, working in cooperation with each other and the main committee could hope to achieve their goal.

Carried to the ultimate, such a plan would raise the status of the operating engineer to that of a semi professional by establishing and maintaining minimum standards of education, classifying the engineers according to training and experience so their credentials were a definite assurance of their ability.

Under such conditions there is every hope of employers realizing that the operating engineer can no longer be browbeaten and if he desires such service it cannot be bargained for in the marketplace but must be bought at full market value.

The road to this goal is neither short nor easy. It would take years of concentrated effort and unless the operating engineers are ready and willing to make the necessary sacrifices there is little hope for any change or improvement in their condition. The older men could hope for

[1] Training of Practical Engineers, page 102, October, 1945.

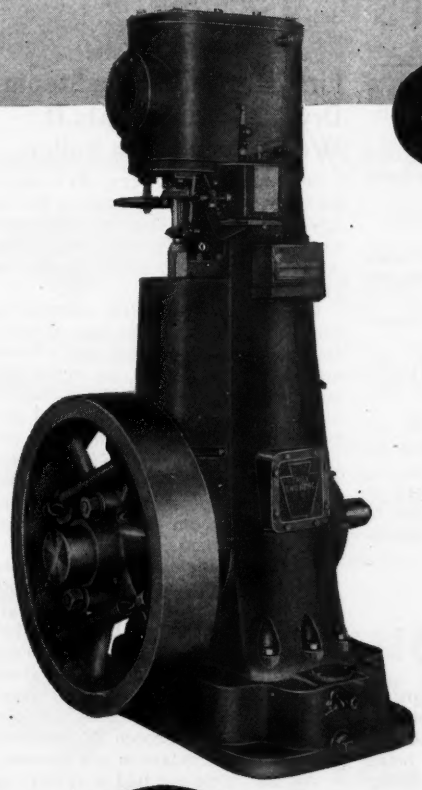
3 LOW COST POWER FEATURES

TROY-ENGBERG STEAM ENGINE

SIMPLE DESIGN

STURDY CONSTRUCTION

CONSERVATIVE SPEED



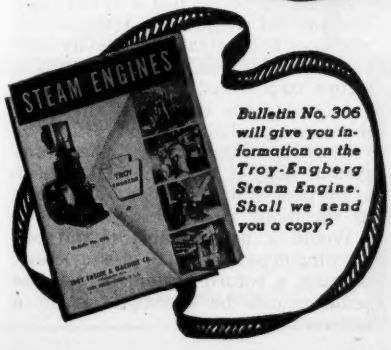
Thousands of Troy-Engberg Steam Engines have been operating for 10 to 20 years, even longer, without need of major repairs. This contributes to the exceptionally low power cost produced by these engines throughout industry.

Why not investigate the advantages of using the Troy-Engberg Steam Engine in your plant? If you use steam for processing or heating and if you are operating such equipment as compressors, blowers, pumps, stokers, generators, etc... you have the setting for a profitable investment in low cost power.

TROY ENGINE & MACHINE CO.

Established 1870

887 RAILROAD AVENUE • TROY, PENNSYLVANIA



Bulletin No. 306 will give you information on the Troy-Engberg Steam Engine. Shall we send you a copy?

TROY-ENGBERG

STEAM ENGINES • GENERATING SETS • GENERATORS

little personal gain beyond the knowledge that any effort or money given for the cause will have brought greater recognition to those who follow in their footsteps. The younger man could confidently plan for a brighter future than is offered today.

There would seem to be little that the individual can do to expedite matters in this or any other plan that may be proposed. Actually he can do much by simply writing to the secretary of the nearest branch of any engineer's organization and inquiring if they have any national plan for improving conditions for the operating engineer and if so, what is being done.

To prevent any misinterpretation of motives, it should be stated at this point that the writer holds no brief and is not a member of any such organization. It being an undeniable fact that organization is necessary in any national effort and existing organizations is the handiest tool for the purpose. Well, Mr. Engineer, just what are you going to do about it?

Questions And Answers

Question No. 330

Will Water Treatment Pay on These Heat Exchangers?

IN A LARGE refinery, where I am a water chemist, a new unit is being installed that contains many water-side heat exchangers. The design on many of these exchangers calls for velocities as low as 3 ft per sec with 130 F outlet temperature.

A large majority of the exchangers designed for these 3-ft-per-sec velocities have the incoming product at 225 F. Another series of exchangers designed for the same velocities have the incoming product at 325 F.

I believe that these velocities are too low for the water to be treated economically for these exchangers, when it is considered that the refinery unit will operate on a shutdown schedule of from nine months to a year.

Those in authority insist that I am unduly concerned over the velocities of water through these exchangers. Please set me straight on this question.

Houston, Texas. J.P.

Quesiton No. 331

How Build This Walk-In Refrigerator?

I AM PLANNING to build a 6-by-6-by-6-ft walk-in refrigerator for use in a home dairy. I must maintain the temperature in this refrigerator between 38 F and 40 F.

I am thinking of using Celotex for insulation and would like to know how many layers of this I would have to use to get good refrigeration.

If there are any other materials suitable for building such a refrigerator that would be better to use, I would like to have some information about them, provided they are available immediately.

I would also like to know what size refrigerating machine should be used for this box.

Amsterdam, N. Y. M.J.B.

EDITOR'S NOTE—Data and methods of making the above calculations are given in:

Refrigeration, 2d Edition, Power Plant Engineering.

Refrigerating Data Book, 5th edition, 1943; American Society of Refrigerating Engineers.

Principles of Refrigeration, W. H. Motz; Chapters XIV and XV; Nickerson & Collins Co.

Further comments from readers on materials and methods effective in their own experience will be appreciated.

Question No. 332

Heating and Purifying Swimming Pool Water

AT OUR UNIVERSITY we have an indoor swimming pool located on the main floor of what used to be our gymnasium, but which is now being remodeled into a Commons Building. This building is located about 75 ft from the power plant.

For some years we have heated our swimming pool water with live steam sent directly from the boilers. This, of course, means that a lot of sediment is shot into the water, which makes it dirty and also probably unsanitary. There is a filter for the swimming pool in the basement of this building but it has never (or at least for a number of years), worked satisfactorily. It is my understanding that it takes some 60 hr to filter the pool with this filter.

I am told that the water can be heated more quickly by using live steam, and have been advised that this might be passed though a system of coils which would eliminate the sediment.

Any information or suggestions you have concerning economical heating and filtering of water for an indoor swimming pool will be appreciated.

R.N.B.

Kansas. Business Manager

Question No. 333

How Big a Relief Valve for Engine Receiver?

HOW DO YOU figure out the size of a relief valve for the receiver of a cross-compound steam engine? Now don't tell me to ask the engine or valve manufacturers, but assume an engine capacity, cylinder dimensions, steam pressures, water rate, and any other factors necessary, and show me just how I can arrive at the proper size of valve myself.

Salem, Mass. J. H.

Question No. 334

First He Wants the Steam Dry, Then He Wants It Wet—from Same Boiler

ON OUR BOILER we carry 80 lb steam pressure and need this amount for our drying tumblers and hot head presses, dry rooms, etc. This works out very well and gives us good drying and very dry steam.

On our wool and silk presses and finishing machines, the dry steam is too dry to do a good job and someone suggested that we cut our steam pressure to these departments so that our steam would not be as dry and do a better pressing job and we have purchased a valve to reduce the pressure to 55 lb. Now I am told by an engineer that a pressure valve will not change the steam as far as the moisture is concerned.

We are changing our entire lay-out in the next month or so and would greatly appreciate it if you could give us any suggestion on how the above problem can be solved with one boiler, supplying both dry and moist steam.

Some years ago we carried even a higher steam pressure than we do today on the same Scotch Marine boiler and had moist steam in our presses.

At that time we had a return system and did not use any traps on the machines but instead had gravity flow to a tank on a lower level where a return trap forced the water back to a receiver over the boiler and from there into the boiler.

I have been thinking that the return system did not keep the water clear of the presses and for that reason gave us the moist steam.

Would it be advisable to put our pressing department (20 presses) back on such a return system or can the same results be accomplished in a different way?

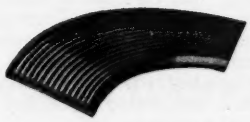
BRING "U.S." YOUR GASKET PROBLEMS!!

Corrugated

Corrugated Asbestos

Corrugated Double Jacket Metal-Asbestos

Solid Metal



Serrated Metal or Profile

QUANTITY?

One or a million.

MATERIAL?

Metal, asbestos, fiber, rubber — anything.

SIZE? SHAPE?

We have it or can make it.

APPLICATION?

Our Gasket Engineers know the answers!

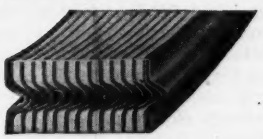
Send a sample gasket, a drawing, a description of the application (or all three) with your inquiry. That is all we need to give you the RIGHT gaskets for your particular service.

UNITED STATES GASKET CO.

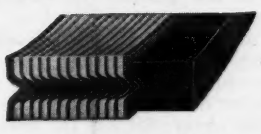
1596 PIERCE AVENUE
CAMDEN, NEW JERSEY

Asbestos

French Type



AJAX Spiral Wound



AJAX S-R Spiral Wound

Oval Solid Metal Ring Type

Single Jacket Metal-Asbestos

Double Jacket Metal-Asbestos

Octagonal Solid Metal Ring Type

I noticed while in a dry cleaning department of a laundry about two months ago that they were carrying 125 lb steam pressure and still the steam on their presses (which happened to be on the 2nd floor) was very moist. I inquired at the time if they had made any provisions for the moist steam at the presses and they told me no.

Could it be in this case that the long run from the boiler room would make some difference?

Pennsylvania. J.E.Y.

Editor's Note—The above question comes not from an engineer but from the manager of a large cleaning and dyeing establishment. Note that the boiler generating the steam is a Scotch Marine Type.

Answer No. 315

How Calculate Steam Flow Through Slots?

IN THE DECEMBER 1945 issue, J.R.D. showed a cubical pipe fitting mounted on the end of a standard 1-in. pipe and asked what formulas and coefficients could be used to calculate the flow of 75-psig steam up through the pipe, then through a V-shaped slot in one end of the fitting and out to atmosphere.

This was definitely a practical problem, said J.R.D., involving determination of the capacity of a second device following the V-slot. However, searching the literature of flow, he had found only one reference, showing how flow through slots was calculated by using Napier's formula $W = pa \div 70$.

Was this good enough, he asked? For various reasons, he said, including the arrangement of the equipment, it was not possible to install a flow meter on the 1-in. pipe line.

In consultation with some of the engineers who really know about measuring and calculating flow, the editor has been searching the various flow meter "bibles" for some help on this problem. So far, nothing better can be found than Napier's formula.

Some preliminary calculations based on this formula give 1018 lb of steam per hour as the flow through the V-slot. This is arrived at by converting the area of the slot into the area of an equivalent circle so that the diameter of the circle can be used in this form of Napier's equation:

$$D = \sqrt{(0.0246\ W) \div (14.7 + P)}$$

in which D = orifice diameter in inches, W = flow in pounds per hour and P = pressure in psi gage.

To measure this flow directly with a meter in the 1-in. steam line, if it is important enough, it is quite likely that some rearrangement of the pipe might be made so that an orifice could be installed in it.

One commercial orifice flange assembly is available for nominal pipe sizes from ¾ in. to 2 in. For 1-in. pipe, the total length of straight pipe required for the installation, including the flange assembly itself, requires only 12 in. straight run of pipe ahead of the orifice and only a few inches following it. In modern practice, according to some authorities, it has been found that the required accuracy is secured with straight runs of pipe much shorter than were formerly believed necessary.

It has been suggested that, if an orifice cannot be installed, there must be a shut-off valve somewhere in the line that could be calibrated and used as a meter. This, say the flow meter engineers, is too complicated and they do not recommend it.

Other engineers raise the point that there must be room enough in the assembly for installation of a variable-area or sight-flow type of meter requiring no orifice.

Finally, if no type of meter could be installed, why couldn't the steam flow be measured by discharging the steam through the slots to a simple atmospheric-pressure condenser, collecting the condensate and weighing it?—THE EDITOR.

Calibrate a Valve to Measure Flow

I PRESUME that by this time someone has answered J.R.D. and informed him that Napier's old formula was only the grossest approximation but about as good as anything he can do for his problem, in view of the turbulent nature of his elbow and the rough interior of the walls. There is also the question of the orifice condition, the interior or upstream edge being of more importance as a possible sharp-edge orifice than the outside or down-stream edge.

With certain assumptions, this case can be formulated, but the necessary simplifying assumptions are violated—so it's no soap. It is easier to calibrate a valve as an onfice and use that to determine the flow. There must be a shut-off valve. The data for doing that are available.

Hopewell, Va. H. E. WEIGHTMAN

Answer No. 316

How Detect Contamination of Heater Condensate by Oil?

IN A CLOSED heat exchanger with oil inside the tubes at higher pressure than the steam outside the tubes, there is always the chance that leakage will contaminate the condensate with oil, said E.H.R. in the December 1945 issue. In this particular installation, the condensate flows to another process in which no oil can be permitted.

Consequently, even though a separator could be installed to trap out the oil, it would be much better, said E.H.R., if they could use some device that would detect heater leakage at once, that could perhaps shut off both steam and oil flows and that would give them full information about internal heater conditions at all times.

In the March issue, W. F. Schaphorst advocated the use of an oil filter with provisions to measure the pressure drop across it as an indication of oil leakage into the condensate. Jesse L. Erisman presented detail sketches of an oil separator for the heater condensate, equipped with electrical alarms and controls.

But suppose oil in some way became emulsified with the condensate? How would either of these methods detect it? Here are some comments on that point.

What If Oil Emulsified?

IN FURTHER REFERENCE to the replies to this question given in the March '46 issue, I submit the following suggestions.

Some oils form emulsions with water that cannot be removed by any filter. Such emulsions may even remain in suspension in the boiler water and not accumulate at the top of a water glass until the concentration becomes excessive. Chemical treatment of such waters will cause coagulation of this emulsified oil so that it can then be filtered out of the water.

I have seen boiler water that appeared to be quite clear and free from oil but when a small sample—25 or 30 cc or about 1 oz—was shaken in a bottle with a few cubic centimeters of chloroform, the chloroform would wash out the emulsified oil from the water. The chloroform settling out at the bottom of the bottle on standing (chloroform being heavier than water) would have a decidedly brown color due to its absorption of the oil from the water.

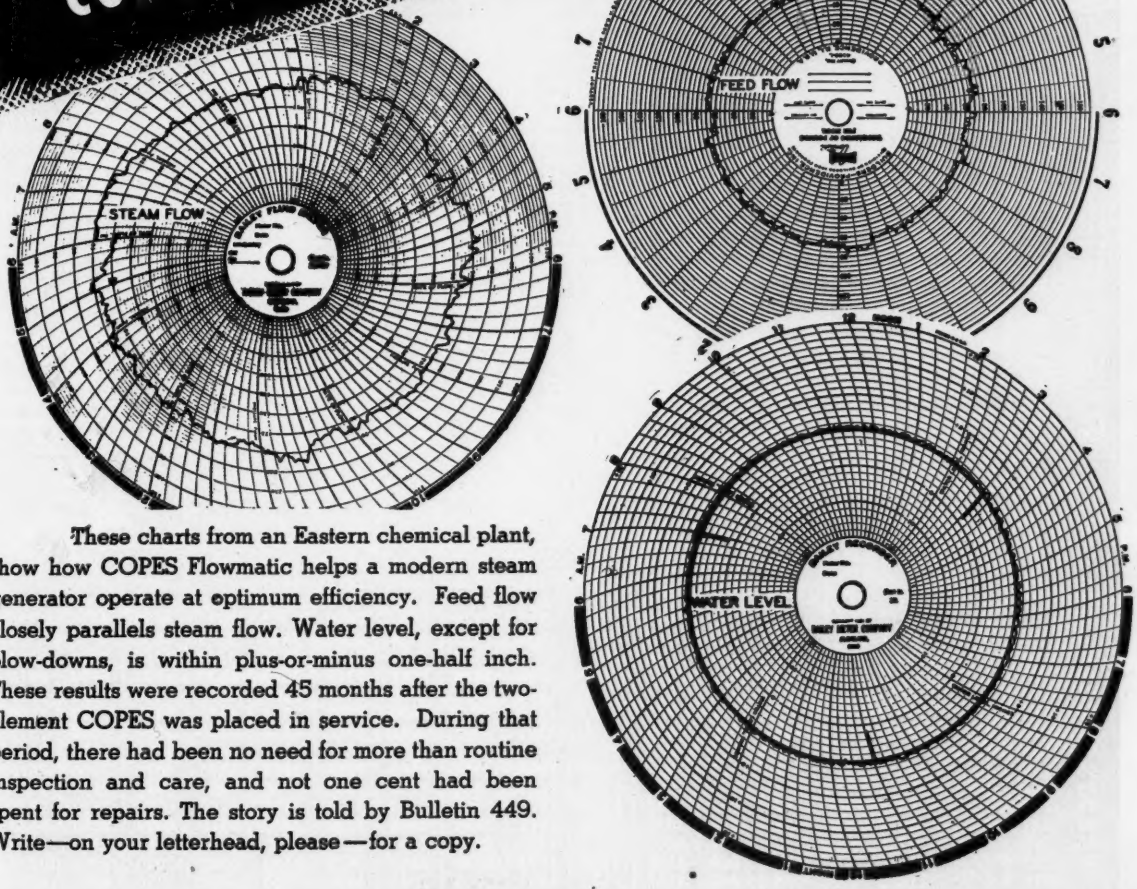
The sample of boiler water should be well cooled before adding the chloroform. In some cases the appearance of the water before and after shaking will change noticeably. With appreciable amounts of emulsified oil present in the water, it may have a bluish or somewhat iridescent cast, which will be removed on shaking, the water then appearing flat and dull compared to its previous appearance.

If the water is decanted from the chloroform and the chloroform with its dissolved oil then poured upon a clean blotter, the oil will leave a stain on the blotter after the choloroform evaporates. This chloroform test may also be made a quantitative means of determining the amount of oil present, if the original sample of water is accurately weighed, the chloroform and oil mixture evaporated, then the remaining oil weighed.

No oil separator or filter will remove emulsified oil, the particles of which range in size down to about 0.00001 in. in diameter. I have seen samples of steam condensate that appeared to be oil-free so far as visual evidence of oil being present; but tests showed 20 parts per million of emulsified oil in the water. Just how much concentration of this water must occur in the boiler before this oil will show in the glass will be dependent upon the chemical nature of the water, coagulants present, and so on.

Erie, Pa. W. W. PETTIBONE.

THE BOILER: Foster Wheeler Type S.A.
DRUM LEVEL: Plus-or-Minus ½ inch
CONTROL BY: COPES FLOWMATIC



These charts from an Eastern chemical plant, show how COPES Flowmatic helps a modern steam generator operate at optimum efficiency. Feed flow closely parallels steam flow. Water level, except for blow-downs, is within plus-or-minus one-half inch. These results were recorded 45 months after the two-element COPES was placed in service. During that period, there had been no need for more than routine inspection and care, and not one cent had been spent for repairs. The story is told by Bulletin 449. Write—on your letterhead, please—for a copy.

NORTHERN EQUIPMENT COMPANY, 562 GROVE DRIVE, ERIE 6, PENNSYLVANIA

Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS: Canada, England, France. ***Representatives Everywhere***

★ **GET CLOSER LEVEL CONTROL WITH THE** COPES FLOWMATIC REGULATOR

FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

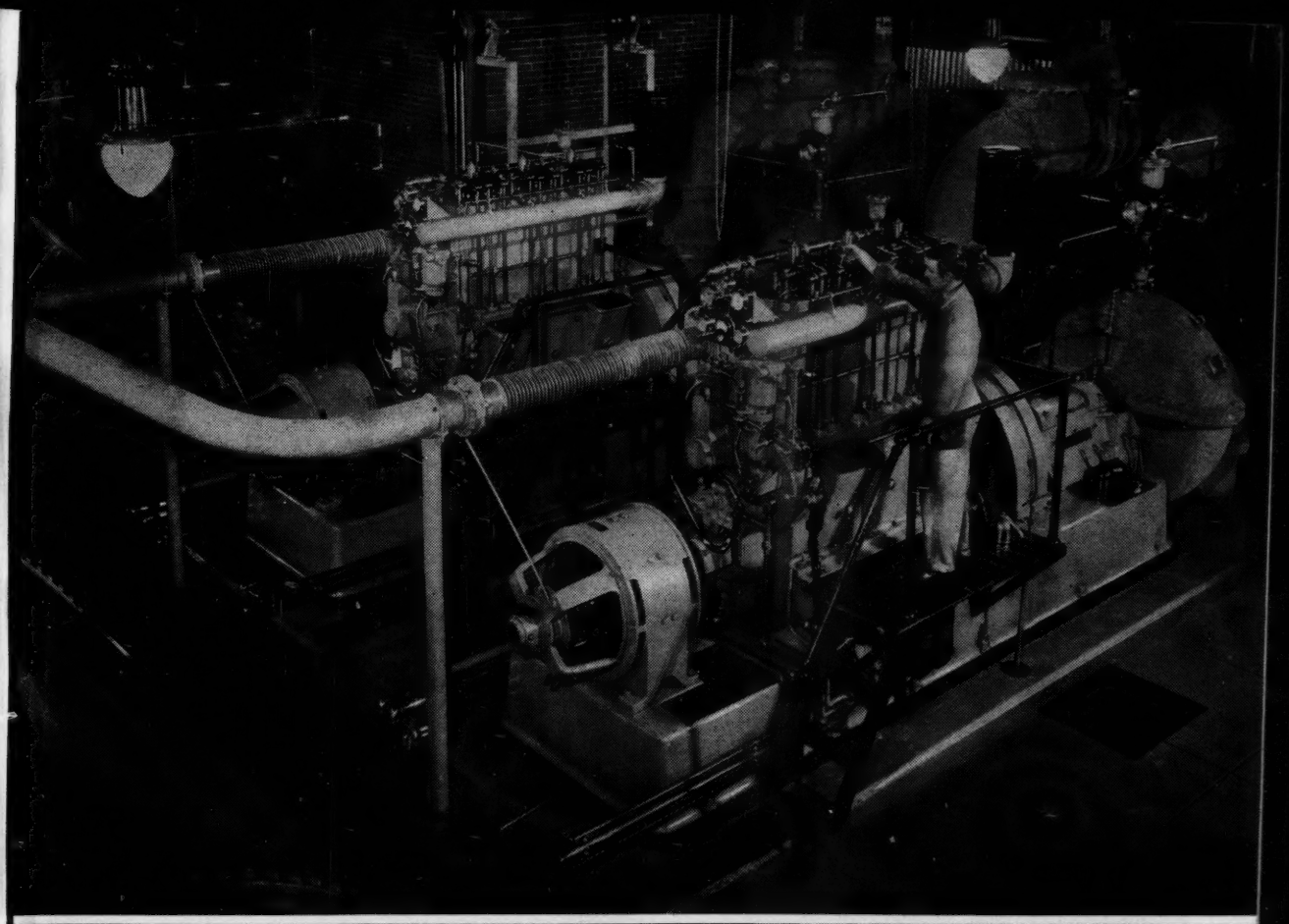
THEORETICAL DISCHARGE OF NOZZLES IN U. S. GALLONS PER MINUTE

Head		Veloc'y of Disch. Feet per Sec.	Diameter of Nozzle in Inches												
Lbs.	Feet		1/16	1/8	3/16	1/4	3/8	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8
10	23.1	38.6	0.37	1.48	3.32	5.91	13.3	23.6	36.9	53.1	72.4	94.5	120	148	179
15	34.6	47.25	0.45	1.81	4.06	7.24	16.3	28.9	45.2	65.0	88.5	116.	147	181	219
20	46.2	54.55	0.52	2.09	4.69	8.35	18.8	33.4	52.2	75.1	102.	134.	169	209	253
25	57.7	61.0	0.58	2.34	5.25	9.34	21.0	37.3	58.3	84.0	114.	149.	189	234	283
30	69.3	66.85	0.64	2.56	5.75	10.2	23.0	40.9	63.9	92.0	125.	164.	207	256	309
35	80.8	72.2	0.69	2.77	6.21	11.1	24.8	44.2	69.0	99.5	135.	177.	224	277	334
40	92.4	77.2	0.74	2.96	6.64	11.8	26.6	47.3	73.8	106.	145.	189.	239	296	357
45	103.9	81.8	0.78	3.13	7.03	12.5	28.2	50.1	78.2	113	153.	200.	253	313	379
50	115.5	86.25	0.83	3.30	7.41	13.2	29.7	52.8	82.5	119.	162.	211.	267	330	399
55	127.0	90.4	0.87	3.46	7.77	13.8	31.1	55.3	86.4	125.	169.	221.	280	342	418
60	138.6	94.5	0.90	3.62	8.12	14.5	32.5	57.8	90.4	130.	177.	231.	293	366	438
65	150.1	98.3	0.94	3.77	8.45	15.1	33.8	60.2	94.0	136.	184.	241.	305	376	455
70	161.7	102.1	0.98	3.91	8.78	15.7	35.2	62.5	97.7	141.	191.	250.	317	391	473
75	173.2	105.7	1.01	4.05	9.08	16.2	36.4	64.7	101.	146.	198.	259.	327	404	489
80	184.8	109.1	1.05	4.18	9.39	16.7	37.6	66.8	104.	150.	205.	267.	338	418	505
85	196.3	112.5	1.08	4.31	9.67	17.3	38.8	68.9	108.	155.	211.	276.	349	431	521
90	207.9	115.8	1.11	4.43	9.95	17.7	39.9	70.8	111.	160.	217.	284.	359	443	536
95	219.4	119.0	1.14	4.56	10.2	18.2	41.0	72.8	114.	164.	223.	292.	369	456	551
100	230.9	122.0	1.17	4.67	10.5	18.7	42.1	74.7	117.	168.	229.	299.	378	467	565
105	242.4	125.0	1.20	4.79	10.8	19.2	43.1	76.5	120	172	234	306	388	479	579
110	254.0	128.0	1.23	4.90	11.0	19.6	44.1	78.4	122.	176.	240.	314.	397	490	593
115	265.5	130.9	1.25	5.01	11.2	20.0	45.1	80.1	125.	180.	245.	320.	406	501	606
120	277.1	133.7	1.28	5.12	11.5	20.5	46.0	81.8	128.	184.	251.	327.	414	512	619
125	288.6	136.4	1.31	5.22	11.7	20.9	47.0	83.5	130.	188.	256.	334.	423	522	632
130	300.2	139.1	1.33	5.33	12.0	21.3	48.0	85.2	133.	192.	261.	341.	432	533	645
135	311.7	141.8	1.36	5.43	12.2	21.7	48.9	86.7	136.	195.	266.	347.	439	543	656
140	323.3	144.3	1.38	5.53	12.4	22.1	49.8	88.4	138.	199.	271.	354.	448	553	668
145	334.8	146.9	1.41	5.62	12.6	22.5	50.6	89.9	140.	202.	275.	360.	455	562	680
150	346.4	149.5	1.43	5.72	12.9	22.9	51.5	91.5	143.	206.	280.	366.	463	572	692
175	404.1	161.4	1.55	6.18	13.9	24.7	55.6	98.8	154.	222.	302.	395.	500	618	747
200	461.9	172.6	1.65	6.61	14.8	26.4	59.5	06.	165.	238.	323.	423.	535	660	799
250	577.4	193.0	1.85	7.39	16.6	29.6	66.5	118.	185	266.	362.	473.	598	739	894
300	692.8	211.2	2.02	8.08	18.2	32.4	72.8	129.	202.	291.	396.	517.	655	808	977

Head		Veloc'y of Disch. Feet per Sec.	Diameter of Nozzle in Inches												
Lbs.	Feet		1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/2	4	4 1/2	5	5 1/2	6
10	23.1	38.6	213	289	378	479	591	714	851	1158	1510	1915	2365	2855	3405
15	34.6	47.25	260	354	463	585	723	874	1041	1418	1850	2345	2890	3490	4165
20	46.2	54.55	301	409	535	676	835	1009	1203	1638	2135	2710	3340	4040	4810
25	57.7	61.0	336	458	598	756	934	1128	1345	1830	2385	3025	3730	4510	5380
30	69.3	66.85	368	501	655	828	1023	1236	1473	2005	2615	3315	4090	4940	5895
35	80.8	72.2	398	541	708	895	1106	1335	1591	2168	2825	3580	4415	5340	6370
40	92.4	77.2	425	578	756	957	1182	1428	1701	2315	3020	3830	4725	5710	6810
45	103.9	81.8	451	613	810	1015	1252	1512	1802	2455	3200	4055	5000	6050	7210
50	115.5	86.25	475	647	845	1070	1320	1595	1900	2590	3375	4275	5280	6380	7600
55	127.0	90.4	498	678	886	1121	1385	1671	1991	2710	3540	4480	5530	6690	7970
60	138.6	94.5	521	708	926	1172	1447	1748	2085	2835	3700	4685	5790	6980	8330
65	150.1	98.3	542	737	964	1220	1506	1819	2165	2950	3850	4875	6020	7270	8670
70	161.7	102.1	563	765	1001	1267	1565	1888	2250	3065	4000	5060	6250	7560	9000
75	173.2	105.7	582	792	1037	1310	1619	1955	2330	3170	4135	5240	6475	7820	9320
80	184.8	109.1	602	818	1070	1354	1672	2020	2405	3280	4270	5410	6690	8080	9630
85	196.3	112.5	620	844	1103	1395	1723	2080	2480	3375	4400	5575	6890	8320	9920
90	207.9	115.8	638	868	1136	1436	1773	2140	2550	3475	4530	5740	7090	8560	10210
95	219.4	119.0	656	892	1168	1476	1824	2200	2625	3570	4655	5900	7290	8800	10500
100	230.9	122.0	672	915	1196	1512	1870	2255	2690	3663	4775	6050	7470	9030	10770
105	242.4	125.0	689	937	1226	1550	1916	2312	2755	3750	4890	6200	7650	9250	11020
110	254.0	128.0	705	960	1255	1588	1961	2366	2820	3840	5010	6350	7840	9470	11300
115	265.5	130.9	720	980	1282	1621	2005	2420	2885	3930	5120	6490	8010	9680	11550
120	277.1	133.7	736	1002	1310	1659	2050	2470	2945	4015	5225	6630	8180	9900	11800
125	288.6	136.4	751	1022	1338	1690	2090	2520	3005	4090	5340	6760	8350	10100	12030
130	300.2	139.1	767	1043	1365	1726	2132	2575	3070	4175	5450	6900	8530	10300	12290
135	311.7	141.8	780	1063	1390	1759	2173	2620	3125	4250	5550	7030	8680	10490	12710
140	323.3	144.3	795	1082	1415	1790	2212	2670	3180	4330	5650	7160	8850	10690	12930
145	334.8	146.9	809	1100	1440	1820	2250	2715	3235	4410	5740	7280	8990	10880	12960
150	346.4	149.5	824	1120	1466	1853	2290	2760	3295	4485	5850	7410	9150	11070	13200
175	404.1	161.4	890	1210	1582	2000	2473	2985	3560	4840	6310	8000	9890	11940	14250
200	461.9	172.6	950	1294	1691	2140	2645	3190	3800	5175	6750	8550	10580	12770	15220
250	577.4	193.0	1063	1447	1891	2392	2955	3570	4250	5795	7550	9570	11820	14290	17020
300	692.8	211.2	1163	1582	2070	2615	3235	3900	4650	6330	8260	10480	12940	15620	18610

NOTE—The actual quantities will vary from these figures, the amount of variation depending upon the shape of nozzle and size of pipe at the point where the pressure is determined.

Chart by courtesy Weinman Pump Manufacturing Co., Columbus, Ohio



Stops SLUDGE... *Chases* CARBON

SUN DIESEL LUBRICANT...

Gives Perfect Lubrication for Sewage Plant Engines, Ends Crankcase Sludge and Carbon Troubles

A Sun Engineer was called recently to a large sewage plant. Two 125-horsepower Diesel engines, connected to centrifugal pumps, were pumping 10,400 gallons a minute.

But sludge and carbon were causing chronic engine-repairs and were crippling the plant. Oil consumption was high.

After 3,974 hours of operation on a specially developed Sun Diesel oil, engineers reported perfect lubrication, freedom from sludge, no carbon, no repairs, no replacements, no overhauls, and very low consumption.

On important power-jobs in municipal plants, or in mills, mines, and factories, more and more experienced engineers are putting their trust in Sun lubricants. For every type of power-equipment, Sun has the right lubricant for peak performance . . . rock-bottom maintenance. Call the Sun Engineer near you, or write . . .

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INDUSTRIAL PRODUCTS

How To Prime Centrifugal Pumps

(Continued from page 74)

a steam air ejector. If the unit is a condensing unit, the vacuum existing in the condenser can be utilized in conjunction with an automatic vent valve to keep the unit automatically primed. However, if there is considerable leakage, the regular steam air ejector serving the condenser may not be able to handle this additional volume of air and the condenser performance will be affected. A regular steam condenser should not be used as a source of vacuum for priming except with tight suction lines and unless the condenser is served by an oversize ejector. Care must be taken with such an arrangement to prevent leakage of water from the pump into the condenser as that would contaminate the condensate. This requires a constant check of the automatic vent valve to insure that it seats tightly.

With a non-condensing steam turbine driven centrifugal pump, a semi-automatic type of priming system illustrated in Fig. 12 can be used if there is danger of air leakage into the suction line.

Controls to Prevent Operation if Not Primed

Various controls depending upon the priming system installed have been used to prevent the operation of a pump if not primed. For most installations some form of float switch in a chamber connected into the suction line is used. If the level in the chamber or tank is above the impeller eye of the pump, the float switch control permits the operation of the pump. If the level falls below a safe value, the float switch acts through the control to stop the pump if running or to prevent its being started if out of service. In the system illustrated in Fig. 6 the longest of the three electrodes is arranged to stop the pump or prevent its starting if the level of the liquid is below this electrode.

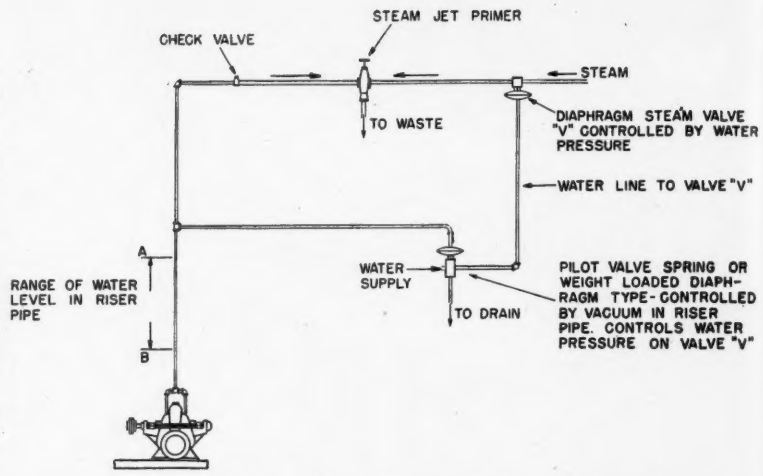

STEAM JET PRIMER
CHECK VALVE
STEAM
TO WASTE
DIAPHRAGM STEAM VALVE "V" CONTROLLED BY WATER PRESSURE
WATER LINE TO VALVE "V"
A
RANGE OF WATER LEVEL IN RISER PIPE
B
WATER SUPPLY
TO DRAIN
PILOT VALVE SPRING OR WEIGHT LOADED DIAPHRAGM TYPE-CONTROLLED BY VACUUM IN RISER PIPE. CONTROLS WATER PRESSURE ON VALVE "V"

Fig. 12. Automatically controlled steam jet primer controlled by vacuum in riser

General

Since there are a great number of automatic priming devices and systems available, care should be taken to use the type or variation that best suits the application. Naturally this discussion and illustrations do not cover all makes and modifications for specific applications.

While an automatic priming system will often allow units to be operated with excessive air leakage into the suction lines, it is a poor practice as it requires the operation of the vacuum producer for a greater percentage of the time.

THE END

Electromagnetic Processes of the Atomic Bomb Project

(Continued from page 85)

was of the order of a hundred fold or more.

One of the interesting things about the chemical operations is the precautions which were taken to salvage every possible grain of uranium whose 235 content has been enriched. It is only by such precautions that the plant capacity is kept up to rating. Some of the precautions are interesting. One of the recovery of splashings from the uniforms of operators in the chemical area. In the cleaning process there is inevitably some splash; and drops of uranium solution are absorbed by the operators' clothing. To recover this, the uniforms are washed every day in small laundries in the individual buildings. The wash water is saved and treated for the recovery of its uranium content. When the uniforms are worn out, they are collected and sent to an incinerator building where they are burned and the ashes digested with acid and treated for uranium recovery. Shoes of the operators are similarly treated. They are periodically collected and likewise burned in the incinerators.

In the separation apparatus a large number of carbon parts are provided to protect the metal structures from beam impingement. These become impregnated with uranium atoms which impact on them. Some of the carbon parts have life of only one run. Others may be used for several runs, then they are collected, and sent to the incinerator building, to be burned in an atmosphere of oxygen. The small amount of ash which results is treated for uranium recovery. Whenever a metal part is replaced the old part is sent to a salvage room and dissolved in acid which is then treated to separate any traces of uranium from the original metal. As may be judged, the salvage operations are an extensive and important part of the plant operation. Several large buildings are provided exclusively for the treatment of salvage solutions.

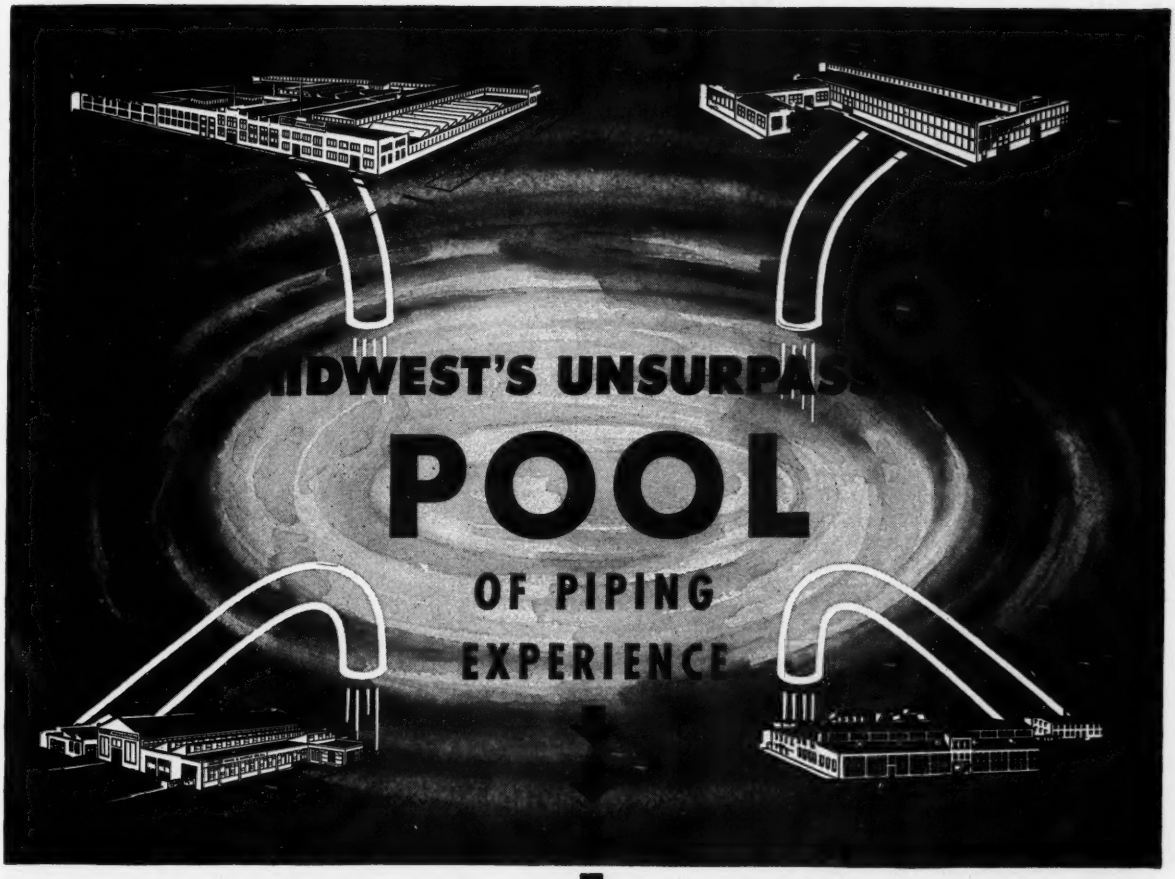
We had numerous difficulties with the design, construction and operation of the chemical units. At times it seemed that we were expected to arrange and re-arrange 250 to 750 gallon tanks and reactors with the same alacrity as test tubes and flasks.

The chemists would have been happy had we been successful in finding out how to get a corrosion resistance equivalent to platinum from stainless steel, glass, porcelain and other common materials. Standard items of equipment were seldom suitable and a great many items of special design were obtained. As a result of this experience, I consider myself qualified to present a definition of a chemical engineer, namely, a darned good mechanical engineer who can recognize a test tube.

With respect to the future possibilities of the electromagnetic process in the development of atomic power, it appears to me to have almost unlimited scope. I believe that method to be most versatile in commercial separation of any of the many isotopes. It should be possible to work out an atomic energy combination that, while not so efficient and violent an explosive as U-235 or plutonium, could be more practical, plentiful and economical for power generation purposes, for example, as gasoline is to TNT.

By the accomplishment of obtaining and successfully controlling relatively large quantities of atomic energy, I believe there has been created a new field for scientific and commercial development of power generation and utilization.

Edison spent years searching for practical and cheap means of converting fuel directly into electrical energy. Maybe we are now nearing something even better than the answer to that problem.



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Continuous interchange of experience data and manufacturing information between Midwest's four pipe fabricating plants results in a pool of piping experience that is unsurpassed by any other organization.

Each plant is fully equipped to do a complete job of pipe fabricating—is staffed by piping experts of long experience and high qualifications. Each plant is always striving to improve its product. A friendly rivalry acts as a stimulant.

Information on new processes and techniques, solutions to unusual piping problems, and generally useful data are exchanged between these plants. One plant will develop an improvement in welding procedure for a difficult alloy . . . another will build a new fixture for saving time in welding . . . etc. For many years this exchange has been building up an unsurpassed pool of piping experience and "know how."

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PIPING FABRICATORS AND CONTRACTORS

Bolting

(Continued from page 78)

number of separate items to be ordered and stocked. By adopting the longest bolt of a given dimeter and providing enough thread on one or both ends, it often is possible to make one item of bolting serve several distinct purposes.

For example, before such a consolidation was effected by Detroit Edison, some 300 combinations of diameter and length were listed for the alloy-steel bolting of pipe flanges used in the company's four power plants. Ten bolt diameters were required and still are, going in ⅛ in. steps from ½ in. to 1⅝ in., but an over generous choice of lengths had been adopted for the various sizes to suit different combinations of flange thicknesses and facings. By cutting down the length steps to about ½ in. and using the longer bolt where the steps came closer together, it became possible to reduce the number of stock items from 300 to 26.

Merits of Full-threaded vs. End-threaded Bolt Studs: Some difference of opinion exists regarding the merits of full-threaded bolt studs vs. those threaded on the ends only. Those favoring a full-threaded bolt contend that it provides more equal stretching throughout its length instead of concentrating stresses at the root of the threads in the few threads remaining below the nut in an end-threaded bolt. On the other hand, where high temperatures are involved and creep is a factor, the lesser amount of stretching under temperature to be expected with the end-threaded bolt may be a factor in maintaining a fluid-tight joint. Actually these distinctions seem of minor importance since both types of bolt have given excellent service and no conclusive proof exists that one behaves much better than the other. Hence it would seem that choice between the two types of threading should be made in any particular case on the basis of economics and manufacturing convenience. To insist from theoretical considerations alone on having one type rather than the other is apt to put a premium on the cost of manufacture without sufficient reason.

If, as seems to be the case, full-threaded and end-threaded bolt studs are about equally satisfactory for use in pipe flanges and pressure vessels, then the choice of which to use can well be left to manufacturing or procurement preference. Where one type is offered for sale at an attractive price and the other is not, or where one type of machine tool equipment is available and the other is not, or where there is preference in which type of material to stock, then these considerations should be the deciding factor in choosing between full-threaded and end-threaded bolt studs.

Midwest Power Conference

(Continued from page 81)

are entirely feasible for the super airliners of the future.

"The next application which promises to be of importance is gas turbine drives for railway service. More and more of the aircraft turbine experience will be funneled into railway applications as rapidly as time permits. High powered locomotives of 7500 or 10,000 hp will some day be hauling the crack passenger trains and high speed freight trains.

"Next in importance is the use of the gas turbine in the maritime industry. Within the near future we are sure to witness one or more trial installations on an efficient gas turbine provided with reversible pitch propellors.

"Somewhat in parallel with the locomotive and maritime applications will be the interest in the central station industry. But, inasmuch as the rewards are lower, it is only natural that this industry offers the smallest field for the use of the gas turbine with the possible exception of 'load peaking' applications."

Engineers and Citizenship

On Friday morning a general session was held in which the subject was "Your Nation's Future, an Engineering Problem." This idea was a new departure for the conference, nonetheless a very timely one. The idea stressed throughout was that the engineer should take a more definite interest in civil and political affairs.

Dean A. A. Potter of Purdue University delivered an enthusiastic address in which he pointed out that welfare of the engineering profession is most closely tied up with government. "Municipalities, states, and the Federal Government," he said, "Are constantly carrying on a variety of engineering operations and are becoming concerned more and more with regulation and even operation of technical enterprises.

Dean Potter emphasized that too often we are willing to place security above opportunity since we cannot have both. He maintains that if we take advantage of opportunity we will provide our own security. And he denounced the widespread concern over the "common man," and stated that it is not the "common man" who contributes most to society but the "uncommon man."

Under-Bunker Conveyors

Conveyors installed under a coal bunker or between a coal bunker and the point of use of the coal, called under-bunker conveyors, were discussed by A. J. Stock of Stock Engineering Co. Five basic reasons for the employment of under-bunker conveyors, he explained, are: (1) To feed coal to stokers or pulverizers which are so located in relation to the bunker outlets that coal cannot be fed to them by gravity. (2) To reclaim coal from the "dead spots" which exist between the principal bunker outlets. (3) To reduce the frequency of coal loading operations. (4) To quickly and easily empty any section of the bunker for repairs or the prevention of bunker fires. (5) To make possible the operation of the boiler plant for the maximum number of hours in the event of a breakdown of the equipment which elevates and conveys coal to the bunker.

At the final session of the conference on Friday afternoon, John I. Yellott, Director of Research Locomotive Development Committee, presented a paper in which he and A. D. Singh, Supervisor of Coal and Gasification Section, Institute of Gas Technology had collaborated, entitled "Coal as the Fuel for the Gas Turbine." Mr. Yellott is a dynamic speaker, and is fired with enthusiasm for his subject.

In discussing the efficiency of the open cycle gas turbine he said "using a turbine inlet temperature of 1350 F, and recovering in the regenerator some 60 per cent of the heat available in the exhaust, the cycle efficiency can approach 30 per cent. When allowance is made for the inefficiency of the combustor and for the effect of pressure losses in the system, the efficiency of the cycle will still remain at about 25 per cent. Such a value, while considerably less than the best figure obtained by contemporary Diesel engines, is still far better than the non-condensing steam cycle can accomplish. As a matter of fact, only the best high pressure, high temperature steam cycles, with regenerative feedwater heating and condensing operation, can attain the same efficiency as the far simpler open cycle gas turbines."

"The few tests which have thus far been made on pressurized combustion indicate that powdered coal can be burned with a heat release of at least 750,000 Btu per hour per cubic foot." . . .

"The problem of burning pulverized coal at a rate exceeding one million Btu per hour per cu ft is currently under intensive study."

In closing, Mr. Yellott said, "The Locomotive Development Committee believes that the coal-burning gas turbine will be a tremendous contribution to the welfare of the railroads and the nation as a whole, because it should enable the nation's most important transportation service to operate economically with the nation's most abundant fuel."

Presented elsewhere in this issue is the paper by L. E. Newman, General Electric Co., "Extraction Turbines for Industrial Power." In the atomics section is R. R. Wisner's paper entitled, "Electromagnetic Processes of the Atomic Bomb Project."

Other papers presented at the conference will be selected for publication in future issues. The entire list of papers was printed on page 146 of the March issue of POWER PLANT ENGINEERING.

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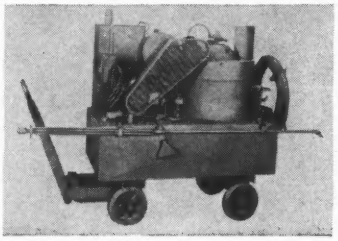
Cleaning Unit Employing Vapor

EQUIPMENT KNOWN as Oakite-Vapor Cleaning Unit has recently been developed by the Oakite Products, Inc., 18C Thames St., New York 6, N. Y. This unit is a self-contained, downdraft flame, oil-fired, enclosed coil-type generator that delivers hot vaporized cleaning solutions under selective pressures up to 200 psi for the speedier, easier removal of grease, grit, grime, paint and other deposits from surfaces. The fuel used may be



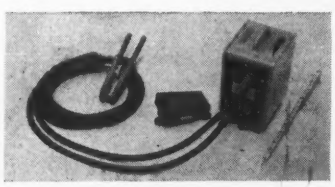
either fuel oil, gasoline or kerosene and due to its flexibility of steam pressures, the unit may be used on many different types of light and heavy-duty cleaning.

The unit is built for long, continuous, trouble-free service and having plenty of reserve power it operates without vibration. Many new, exclusive features are incorporated that provide for simplicity and ease of operation and maintenance, rapid steam generation, unusual solution tank capacity, effective operation of two steam guns simultaneously, wide flexibility in its application to various cleaning operations, safety against fire and other advantages.

Portable Brazers

ALTHOUGH THE METHOD of joining members of copper, brass, bronze and other alloys by means of brazing has been recognized as one of the most reliable, it has been handicapped by the lack of apparatus that can be readily taken to the job. To overcome this drawback the Westinghouse Electric Corp., of East Pittsburgh, Pa., has developed a self-contained family of brazing sets that require only a connection to a 220-v power source.

These sets consist essentially of a transformer for providing high currents at low voltage, suitable voltage selectors, controls, and carbon-tipped tongs that can be clapped over the pieces to be joined. The high currents flowing through the carbons bring them to incandescence, quickly raising the material to brazing temperatures, which are from 1200 to 1500 F.

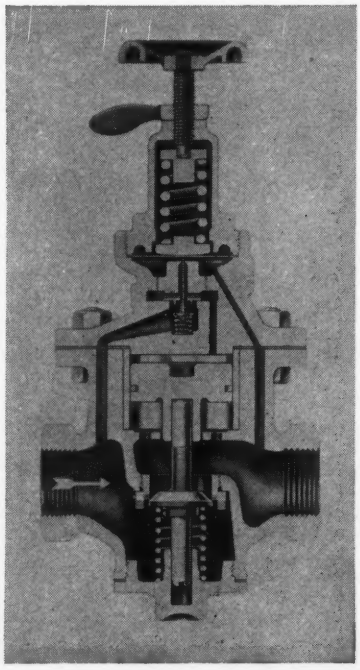


This group of mobile brazing elements is manufactured in three sizes, 5, 10 and 20 kva. The 5 and the 10-kva units are air-cooled. The 20-kva unit is fan-cooled and has a self-contained water cooling and recirculating system used to cool the brazing cables and tongs. This cooling system permits the use of a small-size portable unit for medium brazing work. The smallest unit weighs about 30 lb, the middle-size 100 lb, and the 20 kva, 250 lb. The corresponding secondary currents are 625, 833, and 1667 amp.

Air Reducing Valve

IN ORDER TO HAVE STEADY, accurate regulation and tight closing in a dead-end service valve, the Leslie Co., 257 Grant Ave., Lyndhurst, N. J., has developed a new improved type of internal pilot operated air reducing valves known as Class L-1A.

Its outstanding features are its stability under all flow conditions, and its instant responsive reaction to the widest and most sudden variations in load. Plastic inserts in the valve seats provide positive tight shutoff and long life. All wearing parts are renewable and complete interchangeability facilitates overhauling without removal from the pipe line. Stainless steel main valve, bronze controlling valve and corrosion resistant piston rings help to make this valve corrosion and wear resistant.

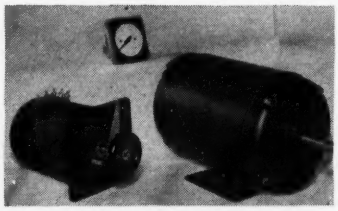


This valve is available in sizes ½ through 4 in. inclusive, designed for initial pressures up to 400 psi air pressure and reduced pressures from 5 to 300 psi. A similar valve designed particularly for accurate control of small air valves is known as class JA-1 and is provided in ¼, ⅜ and ½ in. sizes and is similar in construction with the exception that a neoprene diaphragm is used in place of the bronze piston. This valve has the same initial pressure range and will control reduced pressures from 1 to 300 psi.

Positioning, Indicating Equipment

A-C POSITIONING and indicating equipment which can be operated from any a-c or d-c line is announced by the Allis-Chalmers Mfg. Co., Milwaukee, Wis., for general industrial use wherever remote indication and control systems are employed.

This equipment, consisting of receivers and transmitters, is designed for application in oil fields, steel mills, steam or hydro-electric plants. Specific uses include governor and generator field control systems for multiple synchronized diesel-electric drives, master remote control for reversing mill motors, remote Ward-Leonard control systems for multiple diesel-electric power plant mobile units, and remote indication or control over mechanical, electrical or hydraulic devices such as level, pressure and flow indicators.



It is reported that immediate receiver response without hunting or overshooting is attained over the entire operating range of the system. The receiver is a positioning unit in which the relative strength of the magnetic fields of the stator determines the position that its permanent magnet rotor will assume.

The transmitter, which is essentially a variable resistance bridge, operated manually or automatically, controls the relative strength of the receiver magnetic fields. Receiver and transmitter torques are independent and the receiver torque required to move a device has no effect on the transmitter. The transmitter is designed to operate any number of receivers within rated capacity at any specified direct current voltage.

In this direct current system power requirements are essentially constant under all operating conditions. Overloading the receiver beyond its torque rating cannot damage receiver or transmitter.

Six sizes now available range from five oz in. to 360 lb in. approximate pullout torque, and with a small drip-type rectifier unit may be operated on alternating current.

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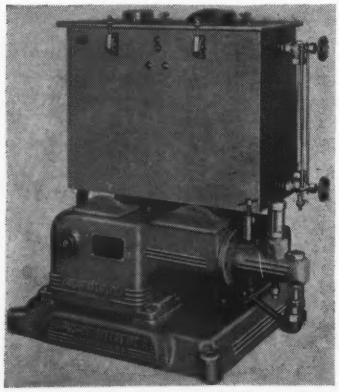
Boiler Water Treatment

A PACKAGED unit for boiler water treatment has just been announced by Proportioneers, Inc., 46 Codding St., Providence, R. I. This new unit includes an Adjust-O-Feeder mounted with a motor on the same base with a chemical tank and agitator. It is designed automatically to feed all



treating chemicals and compounds. This packaged unit is reported to feed chemicals for the control of scale, pitting and corrosion and thereby prolong the life of boilers, improve heat transmission and reduce the need for costly shutdowns.

Duplex Test Set

THE BACHRACH INDUSTRIAL INSTRUMENT CO., 7000 Bennett St., Pittsburgh 8, Penna., is now producing a Duplex Fyrite Test Set, comprising two separate, portable indicators, one for direct carbon dioxide analysis, the other for direct oxygen analysis. The instruments are packed in a compact carrying case, together with aspirator and rubber hose for connecting either to the desired sampling point.

Both instruments employ the fundamental principle of chemical absorption and are reported to give readings that are independent of voltage, humidity, temperature, or atmospheric pressure conditions. Operation of each indicator is identical. For example: A sample of the atmosphere or gas to be tested is pumped into the oxygen indicator by squeezing about a dozen times the aspirator which is attached to the rubber hose. The indicator is then turned bottom-side up and back again, causing the absorbing fluid to mix with the sample and pick up all the oxygen in the sample.

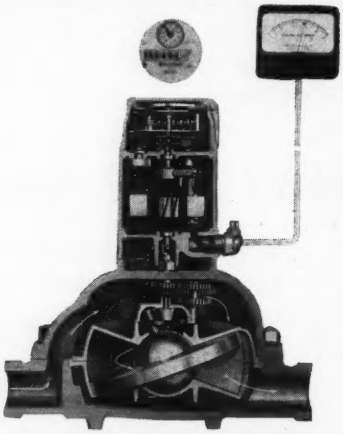
Absorption of the oxygen creates a suction which draws the absorbing fluid up into the graduated tube in an amount equal to the oxygen absorbed. Thus the level of the fluid column shows the percentage of oxygen which can be read directly from the O_2 scale at the right side of the center tube.

Carbon dioxide tests are made by the same method, using the CO_2 indicator. The complete test with either instrument can be made in less than one minute, with an accuracy of within ½ of 1 per cent O_2 or CO_2.

Major features of both instruments include: simplicity of operation, convenience of use, ruggedness, cold-weather proof, spill-proof. The set is suitable for many field and shop tests including checking oxygen content in process gases, heat treating atmospheres, hydrogen cooled generators, and in the nitrogen over the oil in large transformers; measuring oxygen and carbon dioxide content of flue gases, storage atmospheres, etc.

Indicating Flow Meter

THE HAYS CORP., Michigan City, Ind., announces the Hays Veriflow Meter for measuring, indicating, and totalizing various liquids used in industry. The outstanding feature of the new meter is its ability to indicate the rate of flow at a point remote from where the meter is installed.

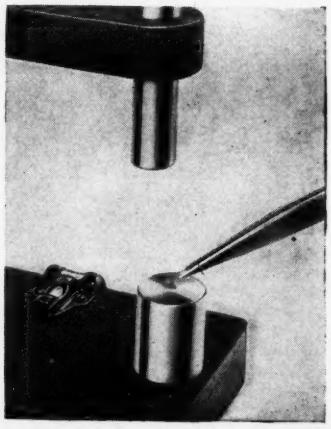


This is in addition to the rate of flow indication and integrator which are integral with the meter itself. To secure the remote indication the generator is mounted on top of the flow meter, the same shaft operating both the generator and the totalizing register. No external source of electricity is required because the indicating meter measures the output of the generator and is calibrated to indicate the corresponding rate of liquid flow through the meter. The scale of the indicator can be calibrated to read in any values of flow desired such as gallons per minute.

The new meter, it is reported, will have an unlimited number of applications such as for measuring, indicating, and totalizing the flow of oil, in testing hydraulically operated mechanisms, the flow of water in chemicals in continuous manufacturing processes, the flow of fuel oil to oil burning furnaces and boilers, the flow of a heating or cooling liquid, the blending of two or more liquids (proportioning), and many other uses.

Magnetic Hardness Tester

A NEW MAGNETIC hardness tester designed for rapid, accurate gaging of hardness of small, ferrous, metal parts has been announced by General Electric's Meter and Instrument Division, West Lynn, Mass. Providing a convenient "go—no go" hardness gage, this tester simplifies inspection



of such parts as electric-instrument pivots and shafts, watch shafts, small steel balls, and other parts too small to be production-tested with mechanical-type hardness testers. It also permits spot checking of hardness in large sheets, or lengths of steel wire, through the comparison of random-selected small samples.

The tester, 6 in. long, 3½ in. wide, and 7 in. high, consists of an alnico bar magnet set in an adjustable, soft-iron frame, which permits the air gap, and thereby the field strength, to be set at the correct value for testing pieces of different size, whose dimensions are between 1/16 and ½ in. A knurled thumbscrew locks the air gap adjustment, and a brass block for positioning the specimens is mounted on the base of the tester, a little out of the direct line of the magnetic field. A two-way level is attached to the base to show when the tester is properly positioned, and a pair of brass tweezers is furnished for handling the specimens.

Oxygen Recorder

THIS NEW AUTOMATIC continuous analyzer for indicating and recording the oxygen content of a gaseous mixture has been developed by Bailey Meter Co., Cleveland 10, Ohio. This instrument has been successfully applied to boiler furnaces, kilns, many types of metallurgical furnaces, glass tanks, chemical and petroleum processes.

Providing a graphic analysis almost instantly the instrument is said to be responsive to changes of 0.05 per cent oxygen. Sustained accuracy is said to be within 0.25 per cent.

Mixed with a vaporized liquid fuel a continuous gas sample is burned on a catalyst-filament which reaches a temperature proportional to the oxygen content. The filament resistance is a function of temperature and

They don't come much more special

★ You won't find a welding fitting like this listed in anybody's catalog. In addition to having integrally formed side walls, probably never before provided in a welding elbow, these are "special" all the way — special steel, special size and special wall thickness.

★ Every one of the hundreds of problems like this that we have tackled and solved across the years has added its important bit to our knowledge of controlling hot metal under pressure and impact. And this accumulated "know-how" has found its best expression in our standard line of WeldELLS and other Taylor Forge Welding Fittings.

That is why you find features in WeldELLS that are not combined in any other welding fittings . . . tangents . . . extra metal distributed where strains are greatest . . . extremely accurate dimensions . . . just to mention a few that call for special processes and complete knowledge of forging technique.

Check the list of features opposite and you will agree that in everything conducive to sound engineering and utmost economy in pipe welding—

WeldELLS alone combine there features:

- **Seamless** — greater strength and uniformity.
- **Tangents** — keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends** —simplify layout and help insure accuracy.
- **Selective reinforcement**—provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field..
- **Wall thickness never less than specification minimum** — assures full strength and long life.
- **Machine tool beveled ends** — provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

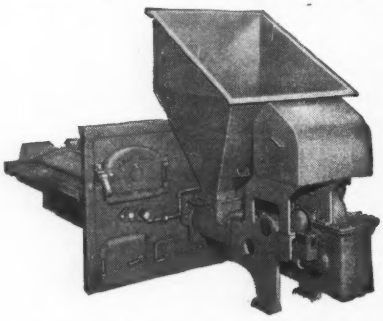
a simple resistance bridge is connected to a null balance electronic recorder which may be calibrated in excess air, per cent oxygen, or other desired terms.

A high speed sampling system for handling dirty, high temperature gases is furnished with the instrument when required.

Oxygen recorders applied to all types of furnaces operating with oxidizing atmospheres permit closer regulation of fuel-air ratios, especially where multiple fuels are used, or where the firing rate changes rapidly. This results in not only increased economy but also in decreased furnace maintenance.

Underfeed Stoker

ERIE CITY IRON WORKS, Erie, Pa., announces two lines of underfeed stokers. The Type L ram type single retort, side dump underfeed stoker is available for power boilers to 360 hp. Type H is of heavier design to carry loads up to the maximum usually



required of a single retort underfeed stoker. Both are available in a wide selection of lengths and widths.

The introduction of these two styles of stokers rounds out the manufacturer's line of complete steam generators incorporating boiler, furnace, water cooling and stoker or pulverizer units.

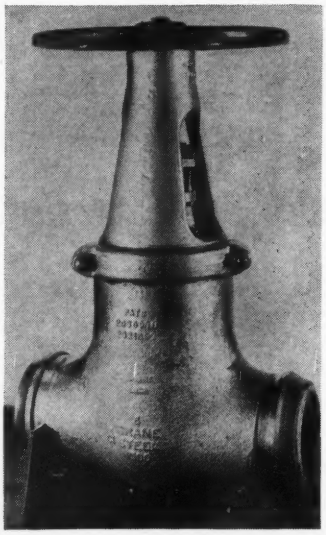
Moisture-Proof Insulation

A NEW MOISTURE-PROOF insulation, Fosterite, has just been announced by Westinghouse Electric Corp., East Pittsburgh, Pa. The company states that this development puts in the hands of the insulation engineers a new weapon in their battle against moisture. It is made of synthetic materials, alkydvinyls, thin liquids which set by the application of heat into what is described as a permanent solid material that is tough and sheds water.

The new insulation was formulated upon the premise that if it contained non-volatile solvents there would be no evaporation of these solids and therefore no voids would be left by the evaporation. The manufacturer warns that the insulation cannot be applied indiscriminately as it is affected adversely in setting by bare copper and by certain asphalts and gums that may be present in some insulations. Its uses have yet to be fully explored but it has proved suitable as a binder for laminated plastics. Also, it has proved useful as a moisture-proof filler for castings.

Pressure-Seal Valves

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill., announces a new line of valves, designed for high pressure, high temperature steam service, primarily in the 1500 lb and 900 lb pressure classes, with welding ends. The line embraces gate, globe and angle, and automatic stop-check valves.



The design incorporates changes and departures from previous conventional types of construction.

The pressure-seal bonnet joint utilizes the pressure in the valve to seal the joint and to eliminate leakage. Maintenance is said to be reduced to a minimum.

Inspections of the interior of valves is expedited by the ease with which the pressure-seal bonnet joint can be taken apart and reassembled. Comparatively little time is required to disassemble this new type of joint and to put it together again.

Other features of the new valves are reduction in weight, a saving in space and the fact that application of insulation is made easier due to the streamlining. Another important improvement mentioned by the manufacturer is a new design disc for gate valves which has built-in flexibility.

Stainless Steel Permanent Magnet Separator

DEVELOPMENT OF A powerful, compact, non-electric magnetic separator with a working surface made entirely of stainless steel has been announced by Eriez Manufacturing Co., Erie, Pa. This new magnet offers a simple and efficient means of removing both large and small pieces of iron and steel trash from coals and oils being used in power engineering.

Tramp metal in fuel fuses in the furnace, causing serious damage and necessitating repairs. These magnets, properly installed, ahead of stokers, will efficiently remove large and small pieces of tramp iron and steel. All types of machines or conveying equipment can be fitted with magnets which are made of magnetic Alnico alloy under the General Electric Co. patents.

For example, when these magnets are installed at any point where raw materials enter a chute or conveyor, they will attract and hold ferrous foreign bodies, preventing them from falling into pulverizing or reducing machinery where they will cause serious damage. These stainless steel magnets may be installed in the bottom of a steel trough, pipeline, or liquid-feeding equipment, where it easily removes ferrous particles from liquids and slurries, preventing material spoilage.

These light, economical Eriez magnets need no wiring, power being furnished by the Alnico steel magnet castings. The magnets are so constructed that under normal conditions their strength will last indefinitely.

Split Bolt Connectors

TO SUPPLEMENT its line of wire connectors and lugs, Ideal Industries, Inc., 1033 Park Ave., Sycamore, Ill., announces the development of a new line of split bolt connectors and service entrance connectors.

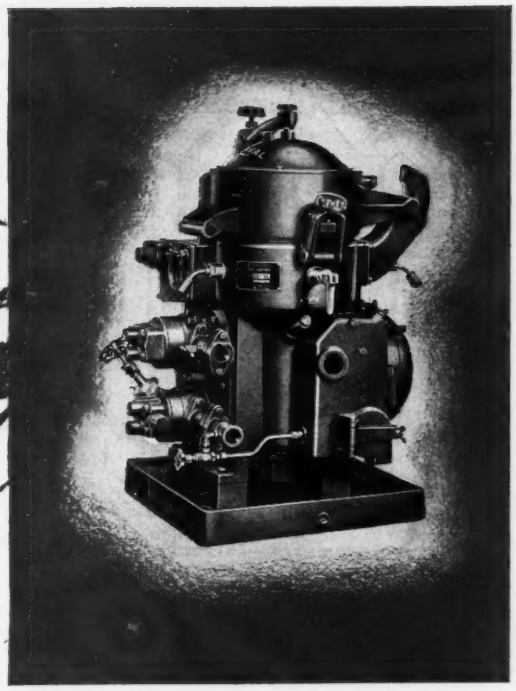
The split bolt connectors are available in two types, "one piece" and "two piece" with small and large heads. They are also available either in bronze, brass, or aluminum. These connectors are precision made from high quality material. There are no burrs, ends, or sharp edges to catch

Above Service Entrance Connector
Left: Split Bolt Connector

in the lineman's gloves. Uniform contact surfaces assure maximum conductivity and low resistance. A wide range of sizes accommodate all solid and stranded wire from No. 6 to 1,000,000 cm.

The service entrance connectors are made from cold drawn copper with the screws made from Everdur. There are five sizes from No. 12 solid or No. 10 stranded to No. 2 stranded.

GIVE YOUR TURBINE . . .



PROTECT your turbine from ***both*** of the chief causes of lubrication failure—dirt and water. To rid the lubricating oil of dirt only is to give the turbine just ***half*** of the protection it requires.

A De Laval Oil Purifier provides a simple, effective means of insuring against the troubles caused by water and dirt. Its purifying action is instantaneous and wholly mechanical. Foreign material is thrown out by centrifugal force, and this centrifugal force removes from the oil and continuously discharges condensate or other water.

If a turbine protected by a De Laval Oil Purifier should develop a water leak, the excess of water would likewise be removed before damage could be done. There would be no sudden formation of "liver" in the lubrication system.

De Laval Oil Purifiers have another inherent advantage—they discharge the purified oil with oil-soluble additives intact.

- Write for Bulletin 400 for details.

DE LAVAL

LUBRICATING OIL PURIFIERS

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
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MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

NEWS from THE FIELD

Lammers Directs Smoke Abatement

H. B. LAMMERS has been appointed Director of Engineering of the Coal Producers Committee for Smoke Abatement, Cincinnati, Ohio. He brings to the position a wealth of experience in the power and engineering field. He is a graduate of Xavier University and of the University of Cincinnati. In addition to this professional work, for fifteen years he taught classes in mathematics, power engineering and combustion at the Ohio Mechanics Institute in Cincinnati.

He joined the Wright Aeronautical Corp. at the outbreak of the war as power supervisor, at Lockland, Ohio, later advancing to assistant plant engineer, after having served for fifteen years as test engineer for the Cincinnati Gas & Electric Co. With the latter organization he handled all phases of central-station operation, maintenance, and testing.

Mr. Lammers is a native of Cincinnati, is married, and has two children. He is the author of numerous technical papers, as well as a book, published several years ago, entitled, "Steam Plant Operation."

Honeywell Expands Factories

AN EXPANSION PROGRAM costing approximately $3,500,000 and involving additions to plants and machinery in four United States and Canadian cities was recently announced by Minneapolis-Honeywell Regulator Co. The new program follows purchase of a ten-story Minneapolis factory and the addition of four floors to the main plant during the war years. Construction of a new wing to the main plants in Minneapolis is planned which will add approximately 120,000 sq ft of manufacturing space to current facilities. Plans include either enlargement by purchase or addition of floor space to current structures now being operated by the Company in Chicago, Toronto and Philadelphia.

New 200,000 Kw Plant for New Jersey

PUBLIC SERVICE ELECTRIC AND GAS Co. plans to construct a new generating station on the Arthur Kill at Sewaren, Woodbridge, Township, N. J. The initial step in the project includes the installation of two 100,000-kw, high-pressure generating units, with the necessary auxiliary apparatus, buildings, docks, coal storage facilities, and electrical switching and transformer equipment and connecting transmission lines, estimated to cost $23,000,000. Engineering work is under way and it is expected that construction work will start in the fall of this year and the new station will be available on the Public Service system in the fall of 1948.

As part of its long range plan of development, the company, about 20 years ago, purchased a tract of approximately 144 acres on the Arthur Kill at Sewaren, for ultimate use as a generating station site. The company's load forecasts now indicate that additional growth, not only in the immediate vicinity of the site but also on the system as a whole, will require a substantial increase in generating capacity in 1948. The Sewaren property is ideally suited to power plant requirements, being centrally located with respect to the system as a whole, and having excellent facilities for delivery of fuel by water or rail and an unlimited supply of water for condensing the steam exhausted from the turbines.

The two 100,000-kw turbine-generators each will be supplied with high-pressure, high-temperature steam by a single large boiler capable of evaporating 450 tons of water per hour. These boilers will be equipped to burn either pulverized coal or fuel oil, or both simultaneously. Under full load conditions, each boiler will burn approximately 950 tons of pulverized coal of 4500 barrels of fuel oil daily. The turbine-generators will be of the tandem compound, condensing type, having a capacity of 100,000 kw. In order to condense the steam after it has passed through the turbines, surface condensers having an area of 55,000 sq ft each will be installed. Water for condensing the steam will be pumped through each condenser at the rate of 70,000 gpm.

The electric generators, delivering power at 13,000 v, will be cooled by hydrogen gas. In order to make the new capacity available on the system, transformers will be installed to connect this station to Metuchen Switching Station and Roseland Switching Station by means of the 132,000-v transmission tower lines, and a lower voltage connection also will be made to existing substations in the vicinity.

Upon completion of the installation, the Sewaren Generating Station will be the most efficient station on the Public Service system. The initial construction is laid out to facilitate further expansion of this station as required by load growth in the future.

Proposed Simplified Pipe and Tube

THE DIVISION OF Simplified Practice of the National Bureau of Standards has recently issued a proposed simplified practice recommendation for copper water tube and copper and brass pipe to producers, distributors and users for their comment or acceptance.

The proposed recommendation covers copper water tube and copper and brass pipe intended for plumbing uses, and its purpose is to establish as a useful standard of practice in the production, distribution, and use of these items, a simplified list of types and sizes.

If the proposal, as submitted, meets with the approval of industry, it will be issued in printed form. In the meantime, however, mimeographed copies of the proposed recommendation may be obtained from the Division of Simplified Practice, National Bureau of Standards, Washington 25, D. C.

Linemen's Protective Equipment

AMERICAN STANDARDS ASSOCIATION has just announced that one of its committees has completed five new Safety Specifications for Linemen's Protective Equipment. The project was undertaken at the request of the War Production Board but the resulting specifications are all suitable for general use in normal times.

Through the work of this committee, specifications were established for outer leather gloves to protect insulating gloves, sleeves, hose to cover

(Continued on page 132)

Coming Events

Smoke Prevention Assn. of America—Annual meeting of the Association; to be held at the Hotel Nicollet in Minneapolis, June 23 to 26, inclusive.

American Institute of Electrical Engineers—1946 summer convention of the AIEE; to be held June 24 to 28, at the Statler Hotel, Detroit.

Society for Experimental Stress Analysis—Spring meeting of SESA; to be held June 24 to 26 at The Hotel Statler, Buffalo, N. Y.

National Assn. of Power Engineers—National Power Show; to be held in Cleveland at the Cleveland Public Auditorium, August 19 to 22, inclusive.

National Assn. of Power Engineers—Annual convention of the NAPE; to be held in Cleveland at the Public Auditorium, August 19 to 22, inclusive.

Instrument Society of America—"Instrumentation for Tomorrow" exhibit; to be held in Pittsburgh at the Hotel Wm. Penn, September 16 to 20.

American Society of Mechanical Engineers—Instruments and Regulators Committee; meeting to be held in Pittsburgh at the Hotel Wm. Penn, September 16 to 20.

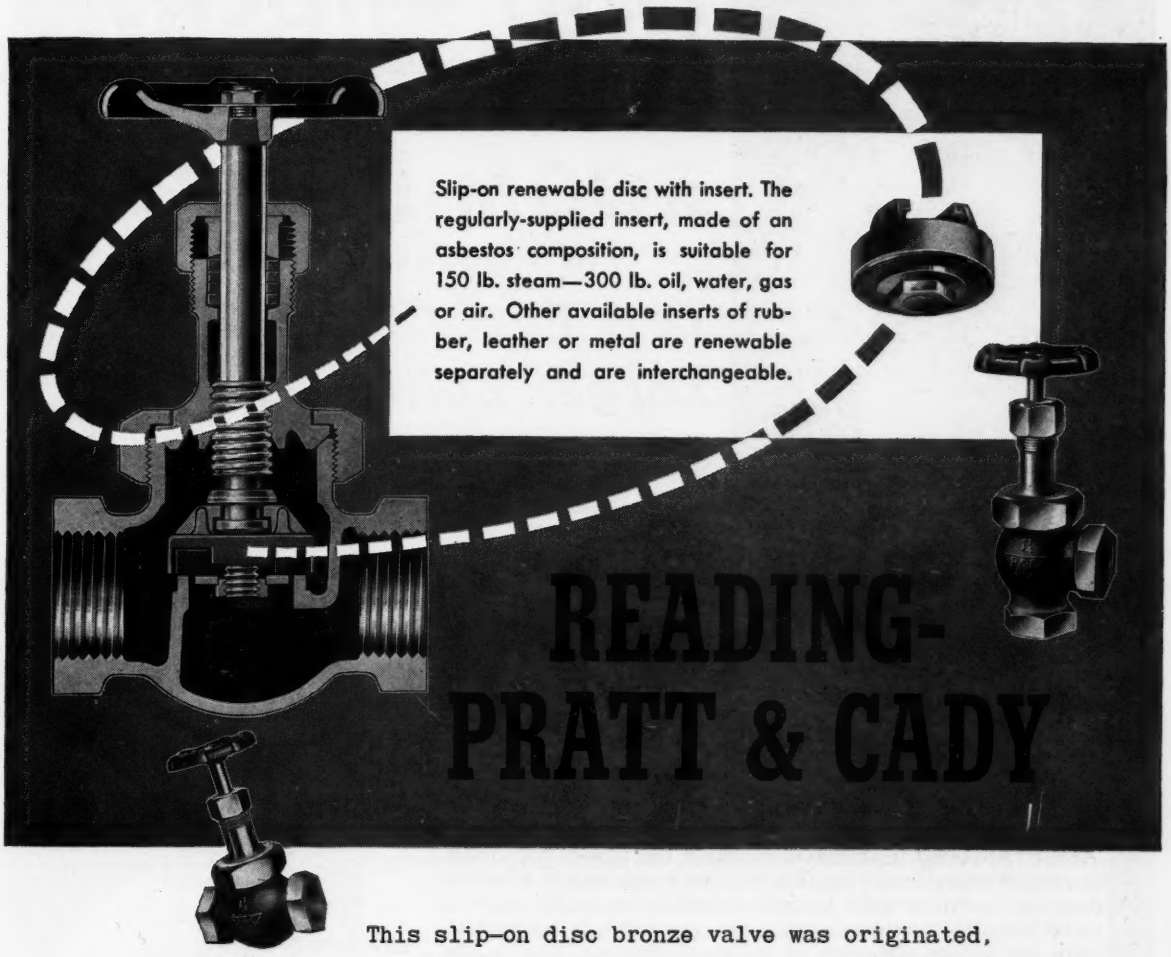
National Electronic Conference—Conference sponsored by Illinois Institute of Technology, Northwestern University and the Chicago Sections of AIEE and IRE; to be held at the Edgewater Beach Hotel in Chicago, October 3 to 5.

American Welding Society—1946 annual meeting to be held in New York City, October 24; headquarters not yet announced.

American Welding Society—1946 annual meeting (reassembly) to be held in Atlantic City, November 17 to 22; headquarters not yet announced.

National Metal Congress and Exposition—To be held in Atlantic City, November 17 to 22, headquarters not yet announced.

Dependable · · Long-lasting · · Versatile
GLOBE and ANGLE Valves


Slip-on renewable disc with insert. The regularly-supplied insert, made of an asbestos composition, is suitable for 150 lb. steam—300 lb. oil, water, gas or air. Other available inserts of rubber, leather or metal are renewable separately and are interchangeable.
READING-
PRATT & CADY

This slip—on disc bronze valve was originated, developed and improved by Reading—Pratt & Cady. Essential to fullest performance are disc guides, cast in the bodies and machined, which extend down to the body seats. This is a versatile valve because a soft disc insert gives a tight closure in a globe type valve, basically a throttling type.

Reading—Pratt & Cady distributors are located in principal cities.

Reading Cast Steel Valves and Fittings • Pratt & Cady Brass and Iron Valves
d'Este Automatic Regulating Valves

ACCO

Reading, Pa. • Atlanta • Chicago • Denver • Detroit • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • Portland, Ore. • San Francisco • Bridgeport, Conn.

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

An Opportunity THAT KNOCKS ON BOILER ROOM DOORS

WITH ASSURANCE OF

Less Fuel Costs
Larger Boiler Capacity
Savings in Maintenance

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

FURNACE DRAFT CONTROLLER

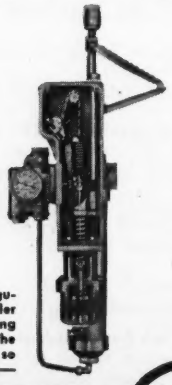
This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from over-fire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

• CASH STANDARD instruments maintain the proper proportion of air supply continuously so that you get continuously effective combustion . . . where such controlled combustion exists, there is no under-firing to cut steam supply nor over-firing to waste fuel. Through the proper operation of the stack damper, heat is not absorbed by excessive air above the fire and thereby lost through the stack . . . the heat goes direct to the boiler water to give you more steam.

CASH STANDARD Units, available in a number of variations, can be combined to make a most accurate and dependable Automatic Combustion Control System to meet any condition and work on any boiler or stoker with any kind of fuel.

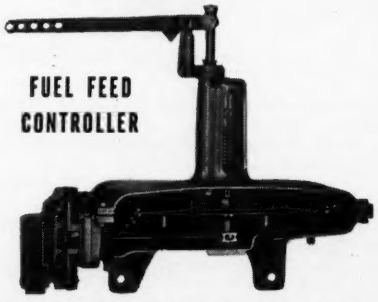
Write today for Bulletin No. 300

AIR FLOW CONTROLLER



This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.

FUEL FEED CONTROLLER



This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

MODERN DEVELOPMENTS OF GASKET RESEARCH

SPIRALWOUND . . .

This Metal-Asbestos "Sandwich"

Makes Sealing Warped and Pitted Flanges *A PICNIC*

SPIRALWOUND — an extremely popular gasket for standard or special flanges and boiler tube caps, hand-holes or man-holes — is composed of interlocking plies of preformed metal, cushioned with Asbestos strip, spirally-wound together.

Under compression, the central spring-like corrugation of the metal strip enables the gasket to seal warped or irregular flange faces and provides unequalled resilience to compensate for expansion and contraction in service. In addition to the multiple-sealing action of this metal strip, the Asbestos cushion also fills irregularities in flange faces to assure a tight closure.

SPIRALWOUND Gaskets have great mechanical strength, are highly resistant to corrosion and temperature extremes, have proper compressibility with relatively light bolting. Rugged construction permits re-use a number of times when seals must be broken.

This better gasket is another example of modern Gasket Engineering. To keep you posted on the latest gasket developments, we will be glad to send you a series of technical bulletins containing original data resulting from continuous research in the unique Goetze Laboratory. Please write on your company letterhead, mentioning your position.

GOETZE GASKET & PACKING CO., INC.
17 ALLEN AVENUE, NEW BRUNSWICK, NEW JERSEY

LOWELL THOMAS Speaks on New Gasket Film

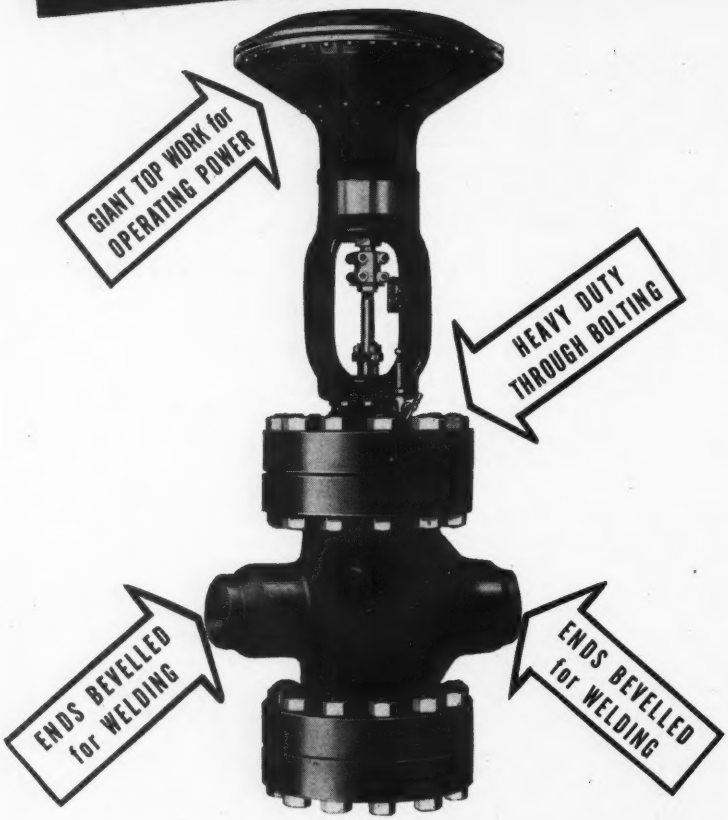
Now available to employee groups, technical societies, engineering schools and other organizations throughout the country, this new 35-minute Kodachrome film, "Only a Gasket," tells why these are the "Biggest little things" in modern Industry. Write for full information.

Goetze for GASKETS

"America's Oldest and Largest Industrial Gasket Manufacturer"

FISHER 57T

WITH Welding Ends FOR HIGH PRESSURE INSTALLATION



The preferred performance of Fisher Diaphragm Control Valves is available for many varied applications. Illustrated is a Fisher Type 57T, 1500 lb. cast steel body, with welding ends for modern power plant high pressure installation. Available with various alloy steel bodies for high temperatures — and other specifications for your individual operating conditions.

Write today for full details.

FISHER GOVERNOR COMPANY
1032 FISHER BLDG. • MARSHALLTOWN, IOWA

Linemen's Equipment

(Continued from page 128)

sections of live wire, hoods for the glass insulators by which wire is attached to poles, and blankets to cover electrified areas. The standard includes tests for toughness and evenness of material because the slightest tingle of current leaking may cause a man to start and touch an unprotected section of wire. The specifications were prepared on a performance basis which offers designer and manufacturer freedom to try out new models and materials and the standard contains a drawing of an easily assembled machine which can be used for experiment.

The Association points out that the committee which developed the standards was drawn from users of power and employers of linemen, manufacturers of protective equipment, insurance companies, governmental and private testing agencies, the Department of Labor and the Union of Electrical Workers.

Copies of the War Standard Specifications for Linemen's Rubber Protective Equipment, may be secured at a nominal price from the American Standards Association.

Standards for U. S., Britain, Canada

THE RELEASE of an official report by the Combined Production and Resources Board now makes it possible for the American Standards Association to give the results of the conference on unification of screw thread standards held last October at Ottawa.

This conference was the culmination of months of hard technical effort on the part of national engineering committees working through the British Standards Institute, the Canadian Standards Association, and the American Standards Association. Agreement was reached that there should be unification of the basic screw threads of the three countries. A technical basis was laid for such unification. The report that came out of the conference consists essentially of recommendations to the industries of the three countries as to how they may carry out the work of unification through their respective national standardizing bodies.

Contract Awarded for Davis Dam

THE UNITED STATES BUREAU OF RECLAMATION has awarded a $21,462,505 contract for the construction of Davis Dam, reported to be the fourth in size of the great structures designed for regulation of the Colorado river. The contract goes to the Utah Construction Co. of San Francisco.

Location of the dam is in Pyramid canyon, 35 miles west of Kingman, Arizona, 64 miles downstream from Boulder Dam. It is estimated that the total cost of the Davis Dam project will be $77,000,000.

Transmission lines and substations will connect Davis Dam with Boulder and Parker Dam systems for transmitting power to the pumping plant of the Bila Irrigation Project (Ari-

The material in a valve must suit the service, POWELL *has all kinds!*

100 YEARS in the School of Experience has taught us many valuable lessons. Not the least of these is the importance of using the *right* valve in the *right* place. Not only type and design but *material* as well must be "just what the doctor ordered."

It is poor economy to use iron when steel is definitely indicated. On the other hand, if iron is thoroughly adequate for the job, there's no sense in using a more expensive material.

The Powell Line of Valves for Power Plants includes Bronze as well as iron Valves for every service where these valves are applicable. And to meet the modern trend toward higher pressures and temperatures in both industrial and utility power plants, Powell offers a complete line of Cast Steel Valves of all types and sizes in pressure classes from 150 to 2500 pounds. This includes an outstanding line of Non-return Valves for positive protection of boiler installations.

Fig. 1303 W. E.

Fig. 1793

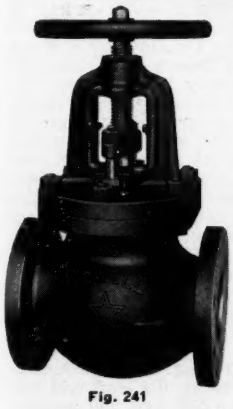


Fig. 241

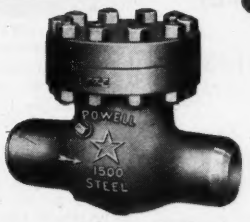


Fig. 1361 W. E.

Fig. 559

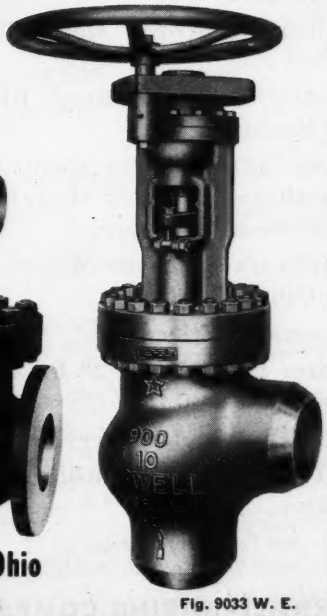


Fig. 9033 W. E.

CATALOGS ON REQUEST
Kindly specify whether you are interested in Bronze and Iron or Cast Steel Valves, or both.

The Wm. Powell Co., Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

Fig. 241—125-pound Iron Body Bronze Mounted Globe Valve. Has flanged ends, outside screw rising stem, bolted flanged yoke, and regrindable, renewable bronze seat and disc. Also available in All Iron.

Fig. 1361 W. E.—Class 1500-pound Cast Steel Swing Check Valve with welding ends and bolted cap. Disc is hung on a 5-degree angle and, when wide open permits full unobstructed flow through the valve body.

Fig. 559—125-pound Iron Body Bronze Mounted Swing Check Valve. Has flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc. Disc, when wide open, permits full, unobstructed flow through the valve body. Also available in All Iron.

Fig. 9033 W. E.—Class 900-pound Cast Steel Non-return Angle Valve with welding ends. Spur gear operated. Powell Non-return Valves are available with spur gear, bevel gear or toggle operation. If desirable, electric motor operators for remote control can be provided.

Fig. 1303 W. E.—Class 1500-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke and taper wedge solid disc.

Fig. 1793—125-pound Iron Body Bronze Mounted Gate Valve. Has flanged ends, outside screw rising stem, bolted flanged yoke, bronze seat rings and taper wedge solid disc. Also available in All Iron.

POWELL VALVES

A Better STRAINER

- Cadmium Plated For Protection Against Corrosion and For Better Appearance
- High-Grade Woven Monel Wire Screen
- Readily Removed Steel Blow-Off Bushing
- Screen and Bushing Come Out Together—Go Back Together, Automatically Aligning
- For Steam Lines or Water, Oil and Other Fluids
- Reasonably Priced
- 6 Sizes from ½" to 2" for Pressures up to 600 lbs
- Many Thousands in Service
- Sold by Over 100 Mill Supply Houses

See Your Supply House or Send for Bulletin S-201

YARNALL-WARING COMPANY
114 Mermaid Avenue PHILADELPHIA 18, PA.

YARWAY STRAINERS

zona); the commercial markets in central and southern Arizona, and the Imperial and Coachella valleys of Southern California.

The dam will be an earth and rock-fill structure and will create a reservoir with a capacity of 1,820,000 acre-feet and will impound water to supply five 45,000 kw generators which will be installed in the power plant.

This project provides that water released from Boulder Dam will be stored again at Davis Dam for release according to downstream needs, including those required by the provisions of the recently ratified treaty between the Republic of Mexico and the United States. Except during flood stage or to fulfill requirements of the treaty, water released by Boulder, Davis, and Parker Dams will be through the turbines of the respective power plants.

New Research Laboratories for Goodrich

ON THE OCCASION of observing its 75th anniversary the B. F. Goodrich Co. which 50 years ago established the first research laboratory in the rubber industry, broke ground for a new and complete research center with construction to be started shortly.

These laboratories will be erected on a 260-acre tract between Akron and Cleveland near Brecksville on one of the highest locations in Cuyahoga county. Present plans call for five separate completely air conditioned buildings built of gray brick.

Among the outstanding characteristics of the new laboratories will be the adaptability for rapid conversion from one type of work to another. Removable partitions, interchangeable fixtures and a wide variety of special services will be employed. It was reported by Dr. Howard E. Fritz, the company's Director of Research, that the company has devoted considerable time to study and arrangement of the project. For example, the building site was chosen primarily because of its freedom from dust, cross-country electric lines, vibration and noise. Quarantining of vibration so that the most delicate operations can be carried out has been the special objective, accounting for the separation of laboratories into five buildings and removal of the whole research project from proximity to any industrial or manufacturing operations.

At the beginning of operations in the research center, the staff will consist of between 220 and 250 persons, but the plans allow for almost unlimited additions and expansions—either by enlarging the buildings already scheduled or by adding additional structures.

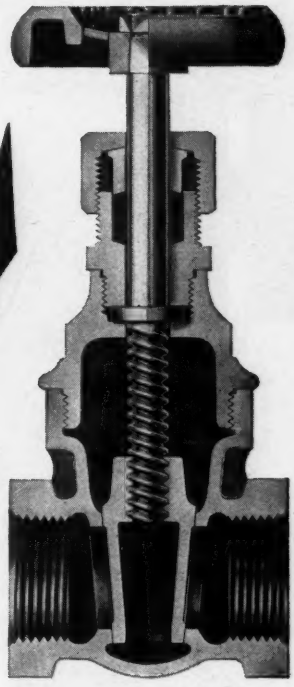
Statistics of Electric Utilities

PUBLICATION OF ITS ANNUAL REPORT entitled, "Statistics of Electric Utilities in the United States," has just been announced by the Federal Power Commission. This publication shows that during 1944 the electrical industry carried forward the record of recent years of consistent improvement in its basic financial soundness, ac-

Every feature you want in a

BRONZE GATE VALVE

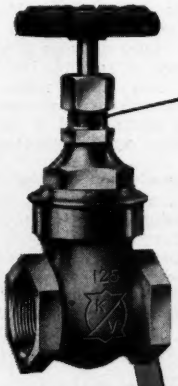
is in this KENNEDY DESIGN



Simplicity . . . and sturdiness . . . these are the two outstanding design characteristics of Kennedy Bronze Gate Valves. There are no small, quick-wearing parts that might cause undue maintenance expense. The heavy bodies and bonnets, large stems with heavily proportioned contact threads, long-proven disc mechanisms, large bonnet hexes and wide pipe-end hexes all combine to provide extra strength, long life and low maintenance expense.

You can obtain these extra-value Kennedy Bronze Gate Valves in a complete range of sizes and for all pressures up to 300-lb. steam. They are available with non-rising stem, rising stem, quick-operating lever and outside screw and yoke . . . screwed and flanged . . . inside screwed bonnet and union bonnet . . . a type for every standard requirement. The 240 page Kennedy Catalog describes these valves in detail . . . your copy sent on request.

Buy From Our Distributor



YOU WANT THESE VALVE FEATURES

. . . you'll find them in this KENNEDY design

1. **Generous Strength . . .** Body and bonnet are of high-grade dense metal with ample thickness and rounded fillets. Stem has large diameter and extra large number of contact threads.
2. **Easy Operation . . .** Stem and stem contact surfaces are accurately threaded. Deep stuffing boxes permit tightness without undue pressure on packing. Large handwheel gives firm, comfortable grip.
3. **Lasting Tightness . . .** Discs and seats seat accurately, and their sturdy design resists distortion and has special provisions for take-up of wear.
4. **Long Life . . .** Many Kennedy valves have been in daily use a quarter century and more.
5. **Convenient Repacking . . .** Glands and packing are easily accessible.
6. **Economical Maintenance . . .** Long wear built into all parts, and adjustments or other attention are seldom required.

THE KENNEDY VALVE MFG. CO.
Elmira, New York

KV-113

KENNEDY *valves - pipe fittings - fire hydrants*

"HOFFMAN DUST REMOVAL HANDED ME AN UNEXPECTED DIVIDEND!"

Many plants, after installing Hoffman Vacuum to eliminate hazards and improve working conditions, have received an unexpected dividend in increased production. Hoffman Dust Removal Equipment will make your plant cleaner, safer, more productive, more profitable. It's the right answer to your dust removal problems.

SEND FOR LITERATURE

U. S. HOFFMAN MACHINERY CORPORATION
AIR APPLIANCE DIVISION, 101 FOURTH AVE., NEW YORK 3, N. Y.

companied by continuing progress in expansion of service and revenues.

This publication is for the year ending December 31, 1944 and details the financial and operating information on every important privately owned electric utility operating in the United States. In this report the activities of 344 utilities which are on the basis of both assets and revenues represent over 98 per cent of the privately owned electric light and power industry, had total assets aggregating $18,-121,791,319 and their total utility revenues for the year 1944 were $3,614,-572,001.

This new publication is devoted principally to detailed uniform tables which show for each utility balance sheets, income and earned surplus statements, capital stock and bonds, electric operating revenues, customers, and sales by classes of service, electric operating expenses, utility plant, and physical quantities. The uniformity of treatment accorded the statements of the various companies will generally permit ready comparison of items among the utilities included in the compilation.

Statistics of Electric Utilities in the United States is a publication of 450 pages dealing with the 1944 data on the industry, and is sold by the Federal Power Commission at $2.00 per copy.

Hathaway ASCE President

GAIL A. HATHAWAY, of the office of Chief of Engineers, U. S. War Department, recently became vice-president of the American Society of Civil Engineers, oldest national engineering organization in the United States, succeeding A. C. Polk of Birmingham, Ala., who died in office.

Mr. Hathaway, a resident of Hyattsville, Md., has been active in sponsoring meteorological studies of flood-producing storms and is author of several works on meteorological studies.

Born near Menomonie, Wisconsin, Mr. Hathaway, an officer in World War I, is a graduate of Oregon State College, and from 1924 to 1928 was assistant to the state engineer of Oregon. He was associated with the U. S. Engineer Department in Kansas City from 1928 to 1937. His work there included, among other things, the hydraulic design of Fort Peck Dam.

An active member of the American Society of Civil Engineers since his election as a member in 1934, Mr. Hathaway was president of the Society's District of Columbia section in 1942.

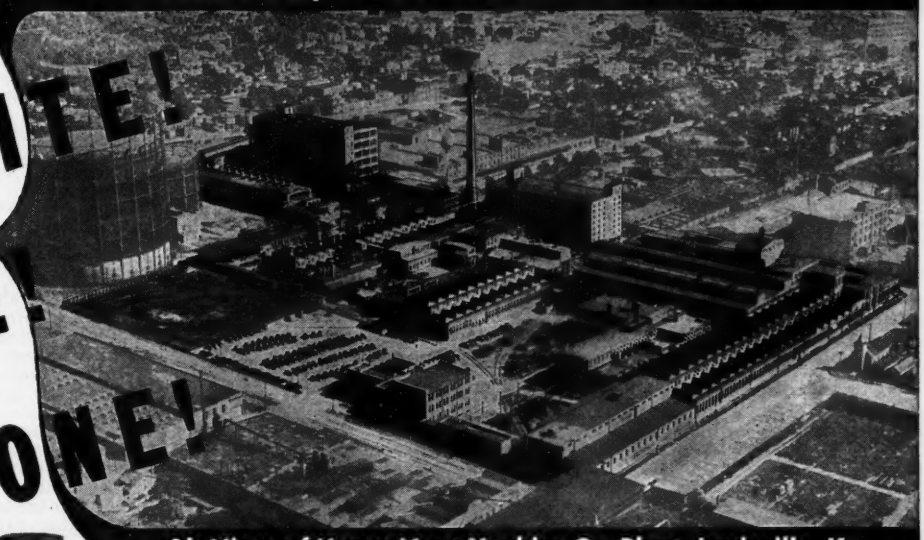
Recommended Practices for Resistance Welding

THE AMERICAN WELDING SOCIETY, 33 W. 39th St., New York 18, N. Y., has published a compilation of recommended practices for the spot and seam welding of low-carbon, stainless and hardenable steels, nickel, monel and inconel; the projection welding of low-carbon and stainless steels; flash-butt welding low and medium forging strength steels; and standard

Headquarters for the

MOST COMPLETE LINE

of DROP FORGED STEEL VALVES, FITTINGS & FLANGES



Air View of Henry Vogt Machine Co. Plant, Louisville, Ky.

WRITE! WIRE! PHONE!

Send for copy of Catalog F-8

VOGT provides one convenient, economical source of supply with the most comprehensive line of drop forged steel piping materials anywhere available to industry. Here will be found everything needed for the safe and efficient control of oil, steam, water, air, gas, and ammonia at high or low pressures and temperatures.

More drop forged steel Valves, Fittings and Flanges are made by Vogt, and deservedly so, because Vogt makes them better!

HENRY VOGT MACHINE CO.
INCORPORATED
Louisville 10, Ky.

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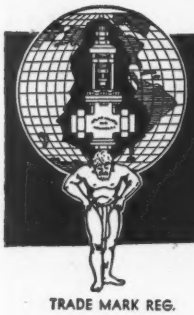
Vogt

DROP FORGED STEEL VALVES, FITTINGS AND FLANGES



TEMPERATURE REGULATORS

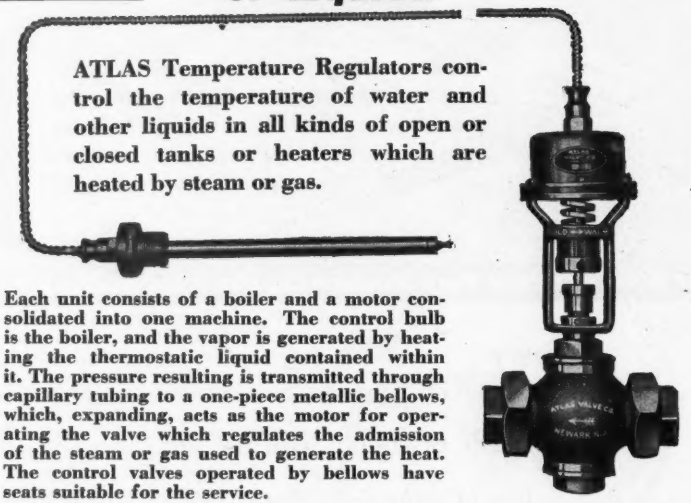
ATLAS

TRADE MARK REG.

1. They Are Self-Contained.
2. They Maintain Perfect Control of Temperature of Liquids.

Write for Bulletin 7A giving detailed information

ATLAS Temperature Regulators control the temperature of water and other liquids in all kinds of open or closed tanks or heaters which are heated by steam or gas.



Each unit consists of a boiler and a motor consolidated into one machine. The control bulb is the boiler, and the vapor is generated by heating the thermostatic liquid contained within it. The pressure resulting is transmitted through capillary tubing to a one-piece metallic bellows, which, expanding, acts as the motor for operating the valve which regulates the admission of the steam or gas used to generate the heat. The control valves operated by bellows have seats suitable for the service.

Number	Specifications
ATLAS No. 650	Balanced Type Double Seat Valve. Spring Adjustment. For temperatures from 70° to 300° F. Bulb is immersed in liquid and control valve installed in steam supply. ½", ¾", and 1" for steam pressures up to 150 lb. 1¼", 1½", 2", and 2½" for steam pressures up to 100 lb. Operates in vertical or horizontal position.
ATLAS No. 651	Needle Type. Single Seat Valve. Spring adjustment. For temperatures from 70° to 300° F. Used where tight seating valve is essential such as on small oil heater pump sets, open or closed tanks, sterilizers, glue heaters, etc. ½" and ¾" for steam pressures up to 150 lb. Operates in vertical or horizontal position.
ATLAS No. 655	Balanced Type. Double Seat Valve. Lever and Weight Adjustment. For temperatures from 70° to 300° F. Lever and weight adjustment of control valve assure high sensitivity. For maintaining temperature of liquids in all kinds of tanks and heaters. ½", ¾", and 1" for steam pressures up to 150 lb. 1¼", 1½", 2", 2½", 3", 4", 5", 6", and 8" for pressures up to 100 lb. Operates in horizontal pipes.
ATLAS No. 660	Single Seat Self-Contained Pilot Operated Valve. Spring Adjustment. For temperatures from 70° to 300° F. For use where accurate regulation demands a quick opening and closing control valve and where steam pressure is always 25 lb. or more, as for instantaneous heaters and tanks for water, oil, etc. ½", ¾", 1", 1¼", 1½", and 2" for steam pressures up to 300 lb. 2½", 3", and 4" for steam pressure up to 250 lb.

Other Atlas Products

Check the items at the right on which you would like to have data and mail to us with your name, firm name and address.

- ☐ Damper Regulators
- ☐ Temperature Regulators
- ☐ Reducing Valves
- ☐ Exhaust Control Systems
- ☐ CAMPBELL Boiler Feed Water Regulators
- ☐ Pump Governors
- ☐ Pressure Regulators
- ☐ Float Valves
- ☐ Oil Control Cocks
- ☐ Humidity Controllers
- ☐ Thermostats
- ☐ Balanced Valves
- ☐ Control Valves

ATLAS VALVE COMPANY

REGULATING VALVES FOR EVERY SERVICE

291 South St., Newark 5, N. J.

Representatives in Principal Cities

methods for testing resistance welds. Each recommended practice comprises a table of machine settings for current, voltage, time, pressure, and other factors, which will produce welds of specified strength in various thicknesses of materials. Explanatory text on each of the factors is included. The section on standard methods for testing resistance welds covers tests for tensile properties, sheer strength, impact strength, fatigue properties and hardness. It includes a complete description of the test specimens, the equipment to be used, and the procedure to be followed. Also included is a section on control of weld quality by statistical methods. The price per copy is 50 cents.

Coal Research Projects

DIRECTORS OF Bituminous Coal Research, Inc., national research agency for the bituminous coal industry, have approved a budget that calls for investing $401,000 in more than 40 research projects intended to improve utilization of solid fuels by railroads, industry and domestic consumers.

This program is an expansion as well as a continuation of the research begun last year and is supported by 240 coal companies and associations. Additional contributions from coal-carrying railroads bring the yearly production supporting BCR to nearly 240 million tons.

More than one-half of the current BCR budget covers projects under way and to be started this year at Battelle Memorial Institute, Columbus, Ohio. The BCR Directors reported that 26 projects had been allocated to Battelle, including fully automatic stokers, smokeless stoves, furnaces, ranges and water heaters, group heating, and chimney design and construction, all in the residential heating field; railroad coal uses, such as air supply, overfire steam-air jets, effect of fuel on locomotive performance, and handling railroad coal; industrial steam and non-steam uses, gasification of coal, and coal drying and preparation.

Principal office of Bituminous Coal Research, Inc., is located in Pittsburgh. Administrative work is directed by Dr. Harold J. Rose, vice president and director of research. He is assisted by Elmer R. Kaiser, assistant director of research, and T. A. Day, special representative. Howard N. Eavenson of Pittsburgh is president of BCR. A Washington office is staffed by C. A. Reed, secretary; M. L. Garvey, treasurer; and J. F. Hanley, assistant secretary-treasurer.

D. C. Prince to Get Lamme Medal

THE 1945 LAMME MEDAL of the American Institute of Electrical Engineers has been awarded to David C. Prince, vice president, General Engineering and Consulting Laboratory, General Electric Co., Schenectady, N. Y., "For his distinguished work in the development of high voltage switching equipment and electronic converters."

The medal will be presented at the Summer Convention of the Institute, to be held in Detroit, June 24-28.

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" BRASS CO. *Headquarters for BRASS, BRONZE, and COPPER*

Extending Condenser Tube Life

Effect of Alloy Composition and Water Composition

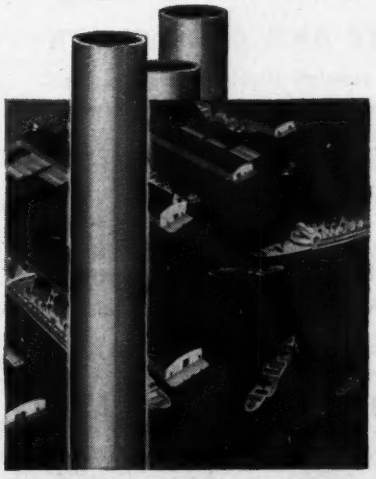
In order to obtain maximum condenser tube life and most satisfactory performance, power plant operators are vitally interested in the cause of premature tube failure as well as factors which lengthen tube life. Numerous laboratory examinations of condenser tubes have revealed a number of different factors which influence the corrosion rate of condenser or heat exchanger tubing in power plants. Among them are alloy composition; composition of water; composition of steam and condensate; nature and distribution of corrosion products; character and quantity of silt and debris; velocities of water and steam; stress; design and operation of condenser; temperatures and pressure; and galvanic coupling. The two factors which stand at the head of the list are water composition and alloy composition.

Effect of Water Composition

The corrosiveness of water depends upon the concentration of dissolved solids and gases; pH value and many other factors. The total mineral content of water varies from less than 0.003 per cent for some natural fresh water up to 3.5 per cent for sea water. The total salt content has a direct bearing on the corrosiveness of the water.

The importance of pH value (hydrogen ion concentration) has been studied in considerable detail and found to vary depending upon the metal being corroded and upon the concentration of all other substances present. A decrease in the pH value usually indicates a rise in corrosion rate. Clean sea water normally has a pH value of more than 8.0, whereas harbors, estuaries and bays may have lower pH values because of contamination from sewage and factory wastes. The higher corrosion rate of harbor water indicates the need for more corrosion-resisting alloys than are required for water in the open ocean. The corrosiveness of natural fresh water with a pH of 7.0 to 8.0 is usually much less than that of sea water with a similar pH. This difference is due primarily to the greater concentration of mineral matter in sea water and is one reason why the average life of condenser tubes in power plants using fresh water is much longer than that of the same alloy in seaboard power plants. The corrosiveness of fresh water with the same values may also vary considerably due to differences in the concentration and nature of the minerals, gases and other substances present in the water. In other words, the pH values should be used in conjunction with the entire chemical analysis of the water. Power plant operators should check pH values periodically and investigate any changes promptly. The subject of water analysis is gaining increasing importance in the operation of power plants.

A high concentration of such gases as hydrogen sulphide and carbon dioxide usually increases the corrosion rate. Organic material and suspended matter varies considerably in effect, and sometimes the decomposition products of these substances cause difficulty. If the suspended matter is ferrous in nature it may protect the material upon which it deposits. Sand and silt may have a scouring action which may be beneficial in cleaning condenser and heat exchanger tubes, but on the other hand this may, over a period of time, reduce the wall thickness of the tubes. However, cinders, sand, mud, wood, stones and other small particles are very likely to lodge in various parts of the condenser tubing and cause deposit attack.



Effect of Alloy Composition

Corrosion studies and metallurgical research have accomplished a great deal in developing alloys which will stand up under higher water velocities, corrosive waters and more severe operating conditions. There is much information available which shows that the addition to copper of such alloying elements as tin, aluminum, nickel, zinc, iron and arsenic, used singly or in combination, very markedly influences condenser tube life.

For example, long experience has shown that the addition of arsenic to condenser tube alloys has resulted in greatly increased service life. The addition of arsenic to Muntz metal inhibits dezincification and reduces general corrosion rate appreciably. In the case of Admiralty, arsenic also lowers the general corrosion rate as well as inhibiting dezincification. Arsenic also improves the corrosion resistance of both Cuzinal (aluminum brass) and Duronze IV* (aluminum bronze). The addition of 0.30 per cent to 0.50 per cent iron and 0.50 to 1.00 per cent manganese to Cupro Nickel has been found distinctly beneficial for retarding impingement, pitting, and general corrosion from sea water. All Bridgeport Cupro Nickel condenser tubing contains iron and manganese. This alloy is used where water velocities and turbulence might cause premature failure of ordinary condenser tubing.

Duronze IV (aluminum bronze) is one of the finest condenser tube alloys available because it has demonstrated its superiority for meeting complex corrosion problems encountered in power plant practice such as tidal estuaries where salt water is mixed with polluted fresh water which may contain sewage, industrial wastes and cinders. This alloy also stands up well in power plants using high velocity water containing entrained gas bubbles which impinge on the condenser tube walls.

Many Corrosion-Resistant Alloys Available

Bridgeport offers a number of corrosion-resistant condenser tube alloys which will give maximum service life when used under conditions for which they are best suited. It will pay power plant operators to contact Bridgeport's Technical Service Department and arrange to try out test lots of these alloys in order to determine which is best. Write for Bridgeport's 112-page Condenser Tube Manual which contains much practical information together with specifications, results of corrosion research and other valuable facts.

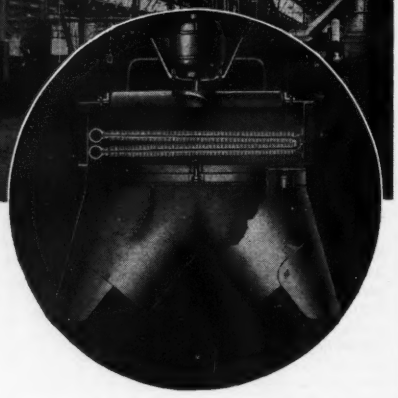
**U. S. Pat. No. 2093380*

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

(Above) Installation of 63 Wing Revolving Unit Heaters in Plant of Automotive Appliance Manufacturer

The objectionable features of inadequate heating systems are the cause of endless complaints.



Cross-sectional view of WING Revolving Unit Heater, showing Motor, Fan, Heating Element and Revolving Discharge Outlets.

WING *Revolving* HEATERS

ELIMINATE HOT SPOTS AND COLD SPOTS

Located at roof or ceiling, they revolve slowly, projecting the heated air to the working level in moving streams which sweep slowly through 360 degrees, covering successively every direction instead of constantly in some one direction. The gentle air motion and the thorough coverage bring a sensation of fresh, live, invigorating warmth to workers. **And in the Summer, with the steam turned off, they create a delightful cooling effect that is equally effective in stimulating production.**

Write for Bulletin HR-3

L. J. Wing Mfg. Co., 64 Seventh Ave., New York 11, N. Y.
Factories: Newark, N. J. Montreal, Canada

Wing REVOLVING UNIT HEATERS

Philips Reports New Scientific Journal

A NEW BI-MONTHLY scientific journal covering theoretical and experimental research in physics, chemistry and other fields, edited by the Research Laboratory staff of N. V. Philips Gloeilampenfabrieken of Eindhoven, Holland, is announced by Dr. O. S. Duffendack, president of Philips Laboratories, Inc., affiliate of N. V. Philips, at Irvington, N. Y.

Volume 1, Number 1, which has just arrived in this country, contains papers on: 1. Theory of the elastic after-effect and the diffusion of carbon in alpha-iron; 2. The current to a positive grid in electron tubes; 3. Theory of the stability of lyophobic colloids; 4. The ratio between the horizontal and the vertical electrical field of a vertical antenna of infinitesimal length.

Among the articles which will appear in subsequent issues are:

Scale glass as a substitute for mica;

Radiation resistance of an antenna with arbitrary current distribution;

Network synthesis, especially the synthesis of resistanceless four-terminal networks;

Extension and application of Langmuir's calculations for a plane diode with a Maxwellian distribution of the electrons.

Nuclear Physics Course Offered Allis-Chalmers Employes

TO ENABLE ITS personnel to become broadly informed on the very timely subject of atomic energy, the Allis-Chalmers Mfg. Co., Milwaukee, Wis., in co-operation with the Illinois Institute of Technology, is offering a special graduate 16-week course on the introduction to atomistics and applied nuclear physics.

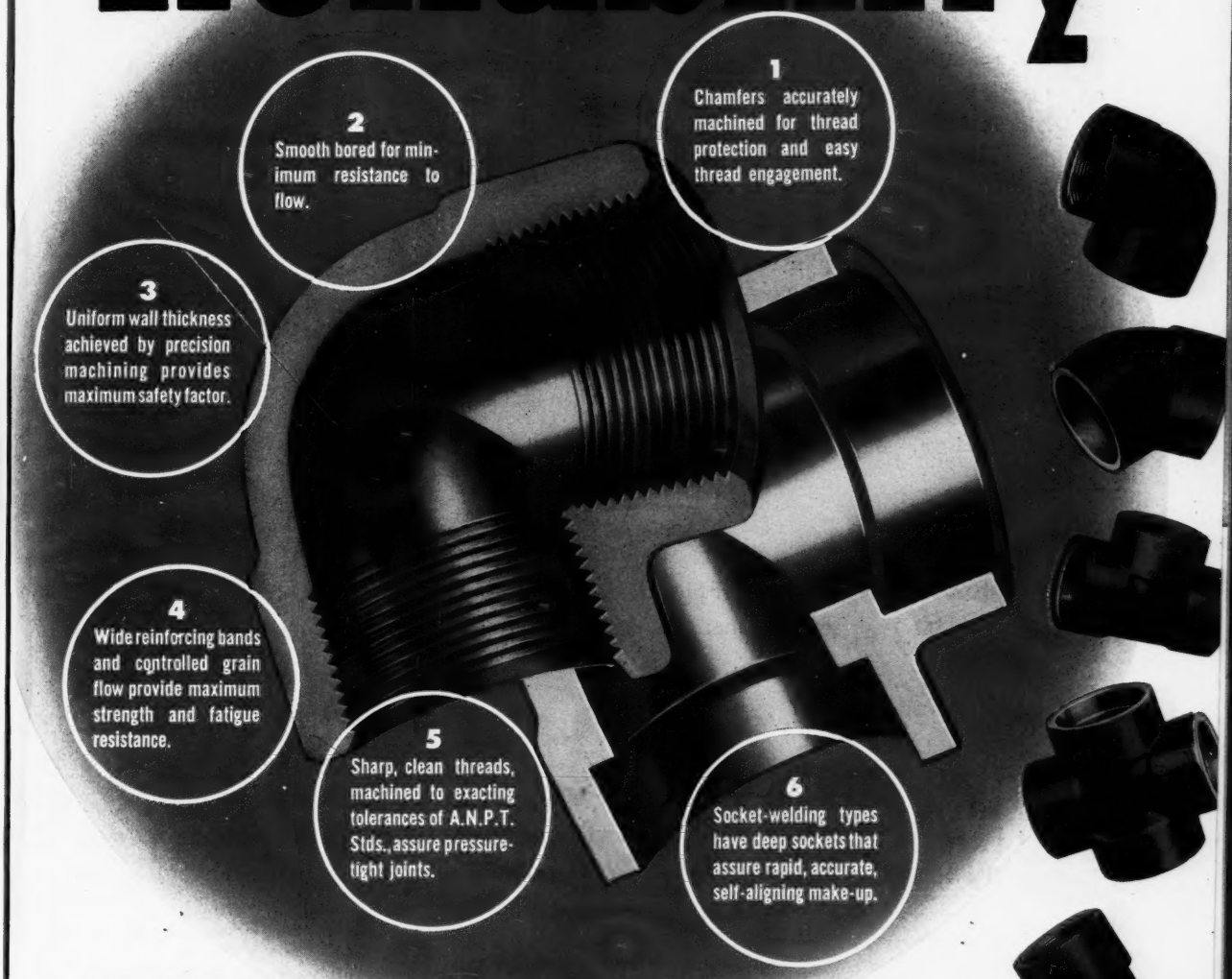
The course presents a series of guest lecturers including such eminent physicists as Dr. Don Kerst, who is chiefly responsible for the practical development of the betatron, and Dr. G. M. Almy, Professor of Physics at the University of Illinois and other leading physicists of the University of Chicago and the University of Wisconsin.

Since 1944, Allis-Chalmers has been offering its employes, in co-operation with the Illinois Institute of Technology, a program of graduate courses in the fields of electrical, mechanical and industrial engineering, physics and mathematics leading to the Master of Science degree in electrical or mechanical engineering.

Chicago Metal Hose Corp. Expands

CHICAGO METAL HOSE CORP., Maywood and Elgin, Ill., has acquired the entire capital stock of Apex Machine Co., Elgin, and will operate the Apex Machine production facilities as a division; the engineering staff of Apex will be operated as a department of Chicago Metal Hose Corp. The capital stock of Apex Machine Co. was acquired through merger proceedings on an undisclosed basis; the merger became effective March 1, 1946.

LADISH Forged Steel Fittings Assure Reliability


1
Chamfers accurately machined for thread protection and easy thread engagement.
2
Smooth bored for minimum resistance to flow.
3
Uniform wall thickness achieved by precision machining provides maximum safety factor.
4
Wide reinforcing bands and controlled grain flow provide maximum strength and fatigue resistance.
5
Sharp, clean threads, machined to exacting tolerances of A.N.P.T. Stds., assure pressure-tight joints.
6
Socket-welding types have deep sockets that assure rapid, accurate, self-aligning make-up.

Quality of Ladish Forged Steel Fittings is closely guarded by rigid metallurgical controls at every step in manufacture. Ladish specialized knowledge and skill make available to you Controlled Quality Fittings that assure dependable performance and ultimate economy.

Controlled Quality

FITTINGS DIVISION

LADISH DROP FORGE CO.

CUDAHY • WISCONSIN (MILWAUKEE SUBURB)

District Offices: NEW YORK • PITTSBURGH • CLEVELAND • ST. LOUIS • HOUSTON • LOS ANGELES

TO MARK PROGRESS

YOUR MAXIM SILENCER CHECK LIST

Check the five types of Maxim Silencers shown against silencing applications in your plant. Each type is available in various sizes to fit specific installation requirements. Detailed information on any of these silencers will be sent on request.

EXHAUST AND INTAKE SILENCERS

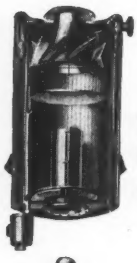
These Maxim Silencers are designed to silence the exhaust or intake of internal combustion engines, steam engine exhaust, air compressor intake, vacuum pump discharge and the intake or discharge of blowers of the positive pressure type.

SPARK ARRESTOR SILENCERS

Maxim Spark Arrestor silencers effectively silence exhaust noise and in addition trap 100% of all exhaust sparks and embers. Widely used in the marine field and in industry where a fire or dirt nuisance hazard exists.

STEAM BLOW-OFF SILENCERS

These silencers were developed for use on installations involving the discharge of high velocity steam, air or gas to atmosphere. They are used to quiet the roar of steam blow-off, safety valve discharges, etc.



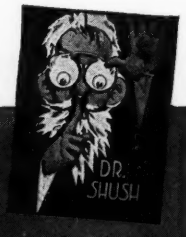
HEAT RECOVERY SILENCERS

Maxim Heat Recovery Silencers combine efficient silencing of engine exhaust with spark arresting (where necessary) and with the recovery of waste exhaust heat to produce steam or hot water for heating or processing operations.

AIR-JET SILENCERS

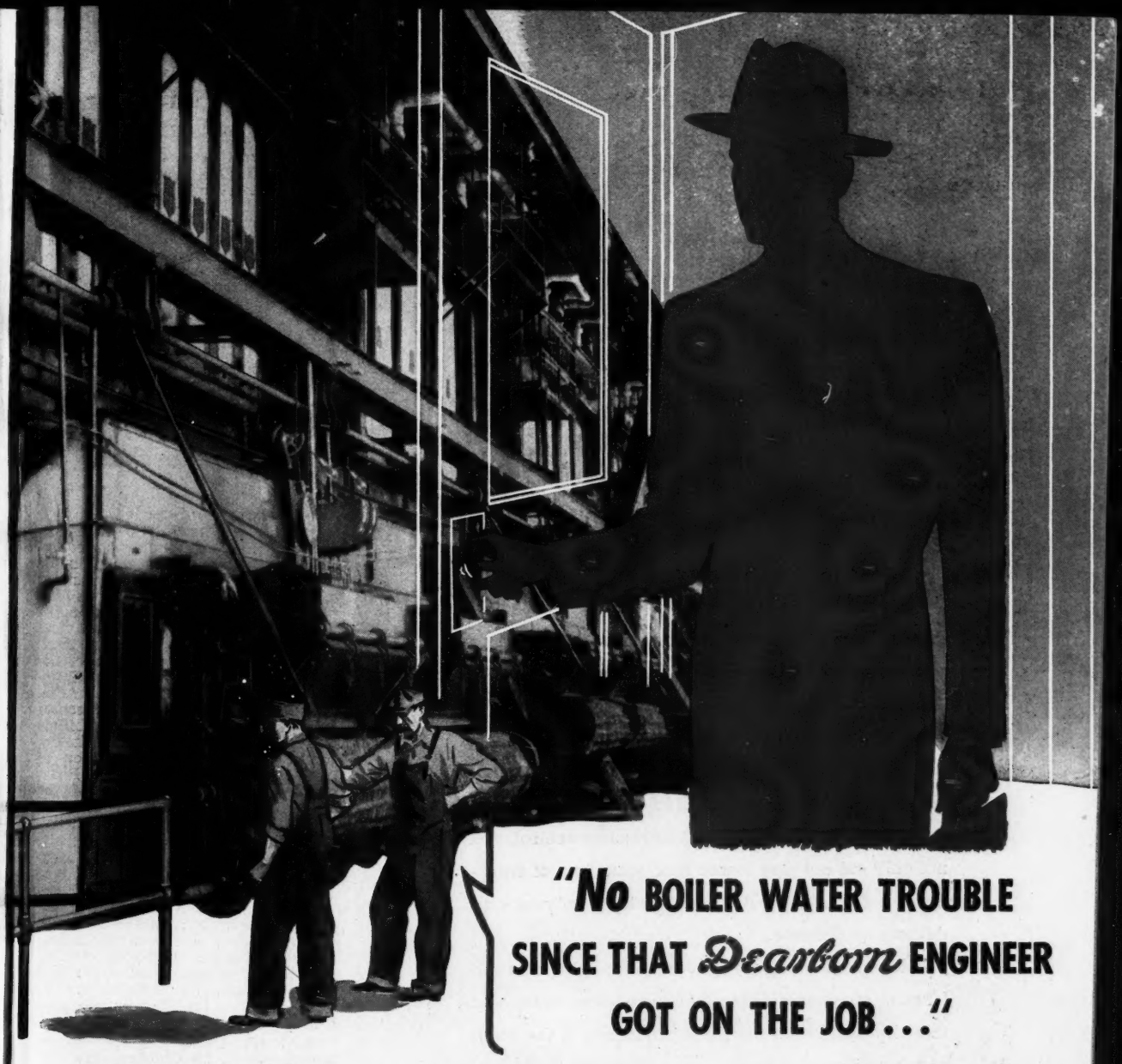
These silencers are jacketed with an air passage surrounding the silencer and cool air drawn up past the silencer while in operation. Jacket protects silencer from elements and is easy to keep painted because it does not heat up.

THE MAXIM SILENCER CO. • **89 Homestead Ave., Hartford 1, Conn.**



ARMY E NAVY

MAXIM



"No BOILER WATER TROUBLE SINCE THAT Dearborn ENGINEER GOT ON THE JOB..."

Dearborn Engineer does this for you...

1. *Studies* your water and plant operating conditions.
2. *Sends* samples of your water to main laboratory for analysis.
3. *Recommends* the proper chemical treatment and correct chemical control methods.
4. *Supervises* installation of feeding equipment.
5. *Instructs* your men on water test methods for treatment dosage adjustment and blowdown control.
6. *Calls* regularly at your plant to insure maintenance of the recommended conditions.

Both management and men are quick to recognize the beneficial effects of Dearborn scientific boiler water treatment administered and periodically checked by the Dearborn Engineer.

Here is a man, within calling distance of your plant, who will head for your boiler room the minute you spot boiler water trouble. He comes equipped to make quick analysis and study operating conditions . . . works with your men to install immediate corrective measures.

His findings are carefully checked by Dearborn laboratories with the result that an individualized treatment is furnished, which, together with continuing Engineering Service, will *end* boiler water troubles in your plant.

When water troubles arise in the boiler room, call in the Dearborn Engineer.

Dearborn

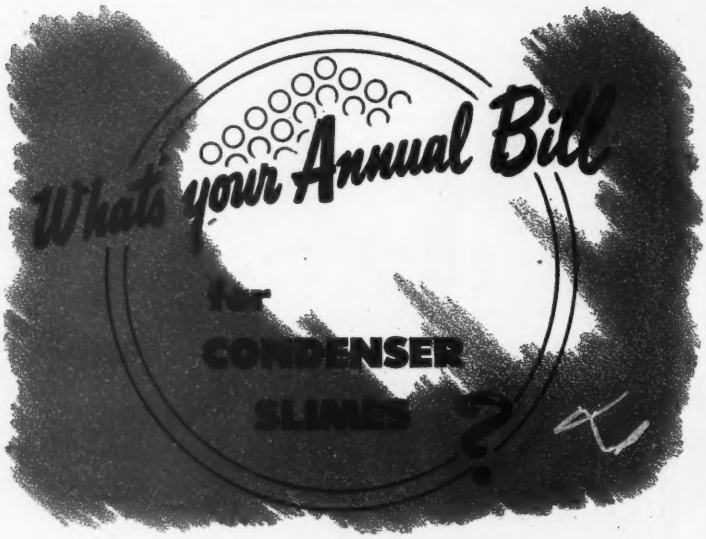
TRADE MARK REGISTERED

THE *LEADER* FOR OVER HALF A CENTURY

ENGINEERING SERVICE AND WATER TREATMENT

Dearborn Chemical Company

Dept. F, 310 S. Michigan Ave., Chicago 4, Illinois



● If you are cleaning condensers by mechanical means, have you figured just how much it is costing you annually? When you do, be sure to include all the "hidden costs" in reduced production – *not only* in time lost when condensers are "off the line", but for all periods when they are not operating at rated capacity, due to slime impaired heat transfer rates.

When you utilize chlorination for slime control, you not only cut out time losses from shutdown of equipment, but you also get rated capacity from your condensers *all the time.*

If deposits already are present on the water-side surfaces of condensers, chlorination removes them, and then, by destroying the slime organisms in the water supply, it prevents the formation of further slime coatings.

To secure the most effective results from chlorination at minimum cost, the method of application and type of chlorinating equipment should be adapted to the individual requirements of your plant. W&T engineers will gladly make recommendations based on an actual survey of your requirements.

WALLACE & TIERNAN
PRODUCTS, INC.
Manufacturers of Chlorine and Ammonia Control Apparatus
Belleville 9, N. J. • Represented in Principal Cities

CD-22S

Boilers Ordered for Sunbury Plant

FOUR STEAM GENERATORS valued at nearly $5,000,000 have been ordered from Foster Wheeler Corp. by the Pennsylvania Light & Power Co.

The order calls for the largest boilers ever designed for direct firing with pulverized anthracite. Each of the units will be capable of producing 400,000 lb of steam per hour at 1350 psi and at 955 F temperature. They will be installed in the Company's new 150,000 kw steam electric station scheduled to be completed at Sunbury, Pa., in the Spring of 1948.

Ebasco Services, Inc., is handling the complete engineering and construction of the new plant.

France to Purchase Equipment

FRANCE IS LOOKING over the best power stations in the United States with the idea of purchasing equipment for expansion of her own plants, according to two French engineers who have just completed a visit here as guests of Hagan Corp., combustion engineers.

M. Jean Commisaire, chief engineer, and J. P. Brutsche, both of the Paris Electric Co., coming to Pittsburgh through James Gordon & Co., Ltd., of England, Hagan representatives, visited the Frank R. Phillips station of the Duquesne Light Co. and the new Springdale station of West Penn Power Co. near Pittsburgh; the Windsor station of the Ohio Power Co. at Beech Bottom, W. Va., and the George Tidd station near Wellsburg, West Virginia.

John R. McDermet, formerly associated with Elliott Co. as assistant to the president, has announced the opening of his own office as consulting engineer. Mr. McDermet will supply advisory service on the industrial use of water, corrosion control, deposit prevention, purification and waste disposal. His address will be 18th and Chestnut Sts., Philadelphia 2, Pa.

The Public Utility Engineering and Service Corp. of Chicago, has announced that LeRoy M. Davis has joined the Engineering staff as assistant hydraulic engineer. Mr. Davis graduated from Cornell University in 1923 and since then has been connected with various power companies on construction, design, research and operation work. He is a member of the American Society of Civil Engineers and American Society of Mechanical Engineers.

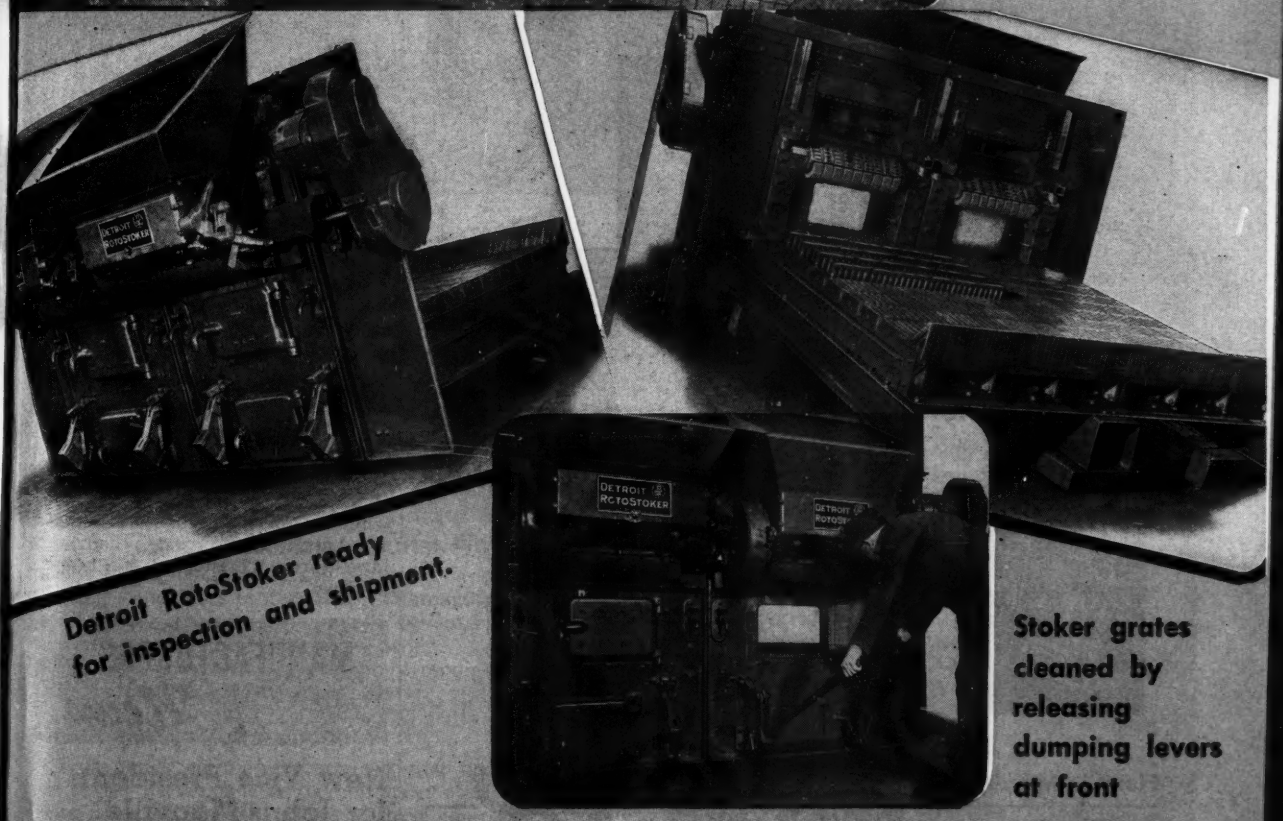
George A. Bryant, president of The Austin Co. of Cleveland, Ohio, has recently announced the appointment of three new vice-presidents. Harold A. Anderson of New York, eastern district manager of the company; Charles W. Payne, Jr., Chicago district manager; and Richard Ellis of Seattle, district manager in the Pacific Northwest. Each of these men has been actively engaged in engineering and construction operations in his district for sometime.

Illinois Institute of Technology, Chicago, Ill., has announced the appointment of Dr. Eric T. B. Gross as professor of electric power system

DETROIT ROTOSTOKER

Hand Operated Dumping Grates

- OVERTHROW ROTORS FOR UNIFORM FUEL DISTRIBUTION
- FUEL AND AIR CONTROLLED—OPERATES WITH HIGH CO_2
- BURNS WIDE RANGE OF FUELS
- HANDLES FLUCTUATING LOADS
- COMPACT—SIMPLE DESIGN
- EASY TO OPERATE



Detroit RotoStoker ready for inspection and shipment.

Stoker grates cleaned by releasing dumping levers at front

DETROIT STOKER COMPANY

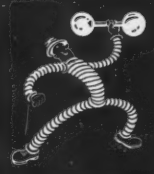
Fifth Floor, General Motors Building, Detroit, Michigan • Works at Monroe, Michigan
District Offices in Principal Cities • Built in Canada at London, Ontario

REX-TUBE

Top choice for tough jobs!

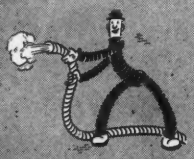
• Put REX-TUBE type RT-15 on your tough, hard-to-handle connection problems. Then watch what happens when this rugged, high-quality flexible metal hose takes charge of the heavy-duty assignments! You can forget all about frequent replacements—costly delays. For RT-15 is famous for its ability to take punishment; to keep right on outperforming and outlasting many other types of hose under the roughest usage you can give it.

There are ample reasons why production men choose REX-TUBE type RT-15 when it comes to taking hard knocks. Illustrated below are just a few of RT-15's many outstanding features. Write us today and ask for Booklet E-144.



REX-TUBE (RT-15)—is strong and well-constructed to take years of wear and tear. Made from heavy strip, steel or bronze. Interlocked design, with inner packing of high-grade asbestos.

REX-TUBE (RT-15)—is widely used for handling steam at low and moderate pressures, for unloading and loading tankers and barges, steaming out tank cars, and other "hot" process jobs.



REX-TUBE—is part of the big, complete C.M.H. family of Flexible Metal Hose. RT-15 is only one type in the REX-TUBE line. There are other REX-TUBE types, in various sizes, with soldered or packed-on couplings, to meet practically any industrial requirement.

Flexible Metal Hose for Every Industrial Use

CHICAGO METAL HOSE CORPORATION

MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

engineering at the Institution. Dr. Gross was formerly an assistant professor of electrical engineering at Cornell University and will devote himself largely to work with Illinois Tech's network calculator, which is designed to set up in miniature and analyze problems in power system design and operation.

Appointment of Clyde A. McKeeman, as Assistant to the President of the American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York 10, N. Y., has been announced. Mr. McKeeman will represent the Society in securing the interest and participation of industry in the Society's research activities. Mr. McKeeman is a native of Maine, and graduated from the University of Maine in 1923, with a degree of B.S. in mechanical engineering. He received his M.S. degree in 1931 from Harvard University School of Engineering.

Obituaries

N. C. Hilton

N. CLIF. HILTON, executive manager of the abrasive wheel, diamond wheel and bowling ball departments of Raybestos-Manhattan Rubber Division, Passaic, N. J., died March 14, in Glen Ridge, N. J.

Mr. Hilton had been with Manhattan Rubber for more than 30 years, having started on November 22, 1915. Under his management Manhattan's abrasive wheel department expanded in production and sales, and research was extended with the addition of an abrasive wheel laboratory.

During World War I, when the import of natural abrasive was curtailed, Manhattan's technicians, under Mr. Hilton's management obtained satisfactory artificial abrasives that have almost entirely supplemented natural abrasives.

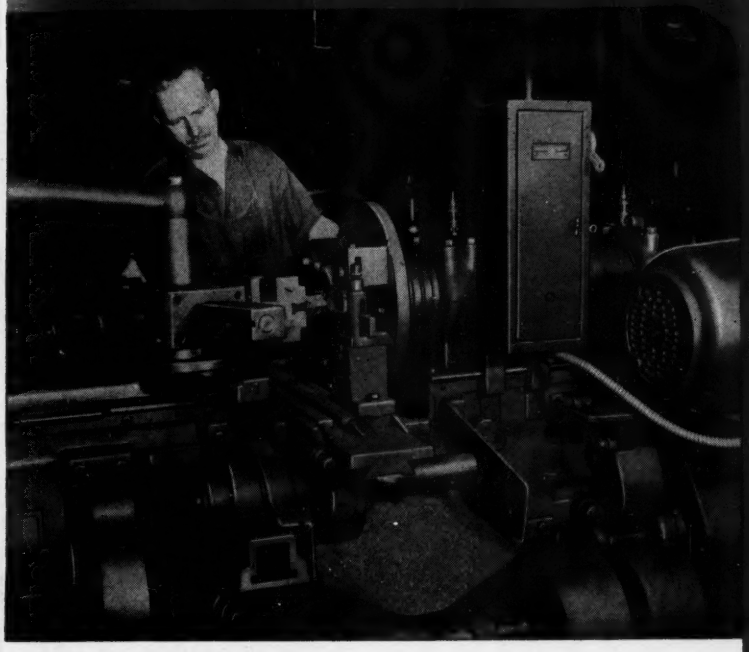
Mr. Hilton was born near Elmira, N. Y., receiving his education in Elmira schools. He is survived by his wife, the former Mabelle Stevens; a son Lamar Hilton, and a daughter, Mrs. Norma Christopher of Pheonix, Arizona.

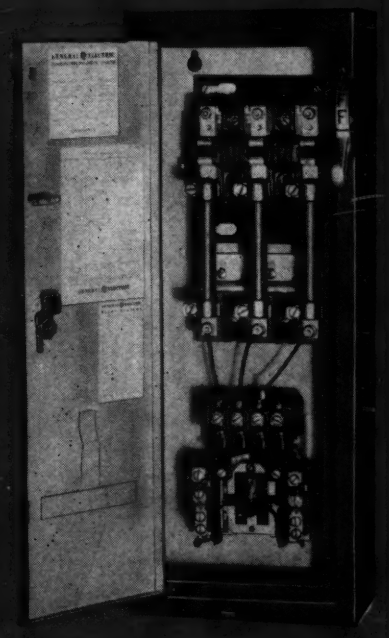
MANUFACTURERS' *News*

New Vice Presidents for Johns-Manville

JOHNS-MANVILLE CORP. has announced the election of L. M. Cassidy and T. K. Mial as vice-presidents of the corporation. The appointments followed the retirement of L. R. Hoff, vice-president of Johns-Manville Corp. in charge of sales. Mr. Cassidy was formerly in charge of the building

300 G-E COMBINATION MOTOR STARTERS...





...give White Motor Company real protection...save time, money, too.

Magnetic starter and motor-circuit switch in *one* unit—G-E "combination" motor starters of this type give co-ordinated control to over 300 machines in the White Motor Company plant in Cleveland.

The starter shown above is installed on a lathe used in making water pumps. Others control drill presses, shapers, boring mills, grinders, and many other types of machines.

Here's Why the Combination Starter Was Chosen

- Fast-acting overload relays protect the motor controlled from overheating—and fuses protect it from damaging short circuits.
- Safety for operators is assured by interlocking doors. While the power is on, the door cannot be opened.
- Quick servicing and availability of repair parts is made possible by G.E.'s broad network of sales outlets.

Wide Field of Application

This motor company represents just one of the many different industries in which G-E combination starters are at work today. Why not give the advantages of these compact, time-saving starters to *your* plant. Our engineers will be glad to help with your application. Get in touch with our local office today. ***Apparatus Dept., General Electric Company, Schenectady 5, N. Y.***

HOW YOU SAVE...

. . . TIME. Instead of buying two devices, you order and install only one. Mounting time is cut as much as 40 per cent.

. . . SPACE. Compact combination starters can be mounted in small unused places near to or remote from the operator.

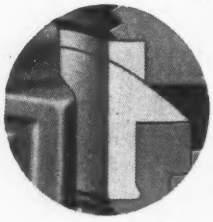
. . . MONEY. The list price is slightly more than for two separate devices, but the difference is more than made up by savings in wire, conduit, and fittings.

MORE INFORMATION about combination starters is given in our Bulletin GEA-3715A. Ask our local office for your copy.

GENERAL ELECTRIC

670-200-8910

Have No Doubt About



THE 2 BRONZE SEATS GROUND TO A TRUE BALL JOINT INSURE LONG WEAR

The super-smooth seats in a Dart Union join without jamming; part without pounding. Besides, the body and nut—made of high-test air-refined malleable iron — are practically indestructible.

For these reasons Darts may be used over and over again. And, naturally, they cost less in the long run.

Your supplier will be glad to demonstrate Darts.

DART UNIONS

E. M. DART MFG. COMPANY, PROVIDENCE, R. I.

materials and general department of the Johns-Manville Sales Corp., and Mr. Mial was formerly a vice-president in charge of power products and industrial department of the same subsidiary corporation.

Electro-Rustproofing Changes Hands

WALLACE & TIERNAN CO., INC., and The Dorr Co. have recently purchased the interest of E. H. Ingle and have become joint owners of the Electro Rust-Proofing Corp. of Dayton, Ohio. E. H. Ingle continues as president and general manager. The present organization is retained and plans are being completed for expansion of research and service departments.

Pressure Vessel Research

A RESEARCH PROGRAM covering materials, design, fabrication, inspection and testing of unfired pressure vessels has been started by the Welding Research Council, which is sponsored by the American Welding Society, American Society of Mechanical Engineers, American Institute of Electrical Engineers and other engineering societies.

This program has been initiated to furnish quantitative data needed by those engaged in pressure vessel design and construction to insure sound design and reasonable life. During the war, experimental work had fallen behind the increased use of both carbon and alloy steels in larger and more complex designs of welded vessels used in process industries under increasingly severe service conditions. The lack of factual information, has resulted in acknowledged over-conservatism in design and has hastened the start of the new research program.

The chairman of the new Pressure Vessel Research Committee is Walter Samans, who is also chairman of the ASME Boiler Code sub-committee on unfired pressure vessels and the first meeting of the new committee was held on January 10, to sift those problems of greatest need, based on reports of defects developed in service, and to plan coordination of the new investigations with other committees and research already being conducted.

At this meeting, employment was authorized of a full-time New York headquarters secretary to collect and maintain adequate records and to correlate the projects approved with the research facilities and personnel of selected university laboratories.

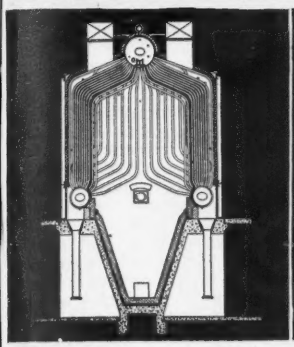
Winning Support for Incentive Plans

IN A RECENT ADDRESS A. C. Croft, president of the National Foremen's Institute, stated that in order to win employee support one midwestern company:

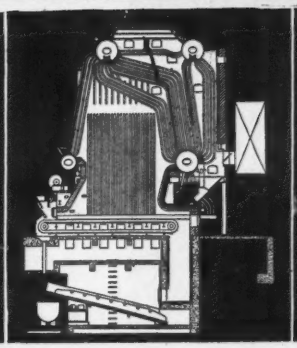
1. Explains and demonstrates to union officials in advance just why the changes are necessary and gets their reactions and—if possible—agreement that the changes should be made. In addition to winning the union's confidence and support, such explanation will usually elicit technical suggestions of practical value to

• DIRECTORY of UNION • BOILERS

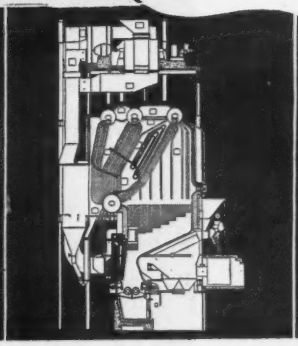
UNION IRON WORKS • ERIE, PENNSYLVANIA



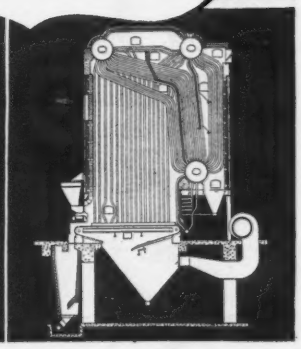
H-TYPE, a self-contained steel cased generator unit for any fuel or firing method, for any desired capacity or pressure.



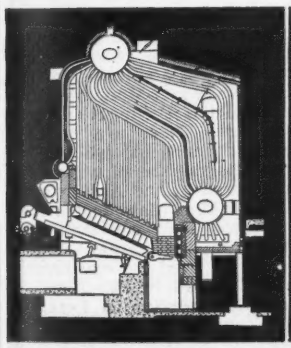
N-TYPE, 4-drum steam generator doubles the radiant surface of other designs without the use of water walls and auxiliary headers.



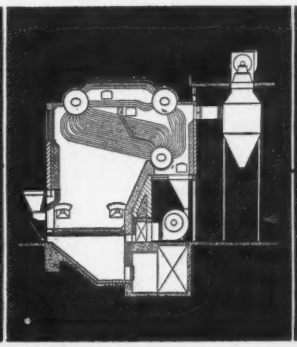
B-TYPE, 4-drum design. Gas, Oil or low fusion Western coal can be readily burned in this furnace which is water cooled and provided with cast iron armor protection.



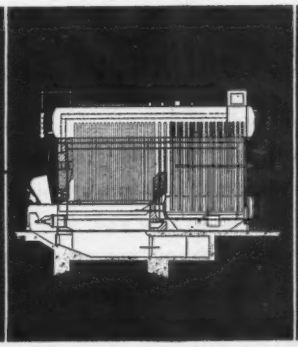
A-TYPE, 3-drum design with special front bank tube curvatures to increase the radiant surface, accelerating speed of circulating and rate of steaming.



O-TYPE, fully water cooled furnace with all water wall supply tubes inside the setting. A minimum of unprotected brick-work is exposed in the furnace.

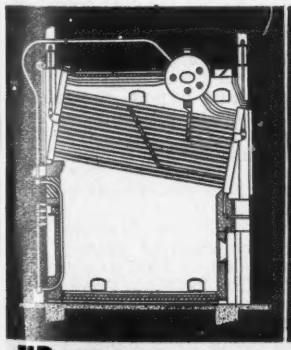


L-TYPE, for low headroom conditions, two top drums at the same level providing maximum steam disengaging surface. Many sizes can be shipped shop assembled.

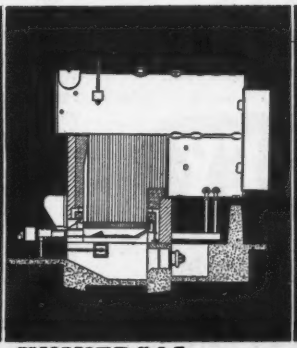


S-TYPE, provides water walled furnace that does not require circulator connections, the setting except for front and bridge walls is constructed of refractory tile water cooled, insulated steel panel cased.

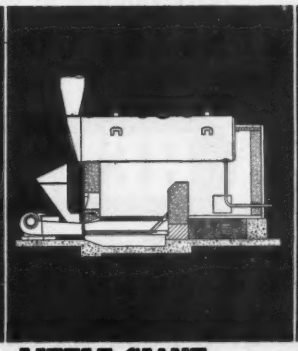
LD-TYPE, long drum with box header construction with either single or double horizontal drums. A thoroughly standardized unit built in units as large as 7,000 square ft. of heating surface.



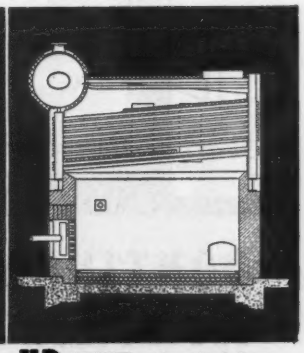
XD-TYPE, cross drum box header type, with steep inclination to the main tube bank to promote rapid circulation — Smaller sizes can be shipped fully assembled or tube bank assembled and drum detached.



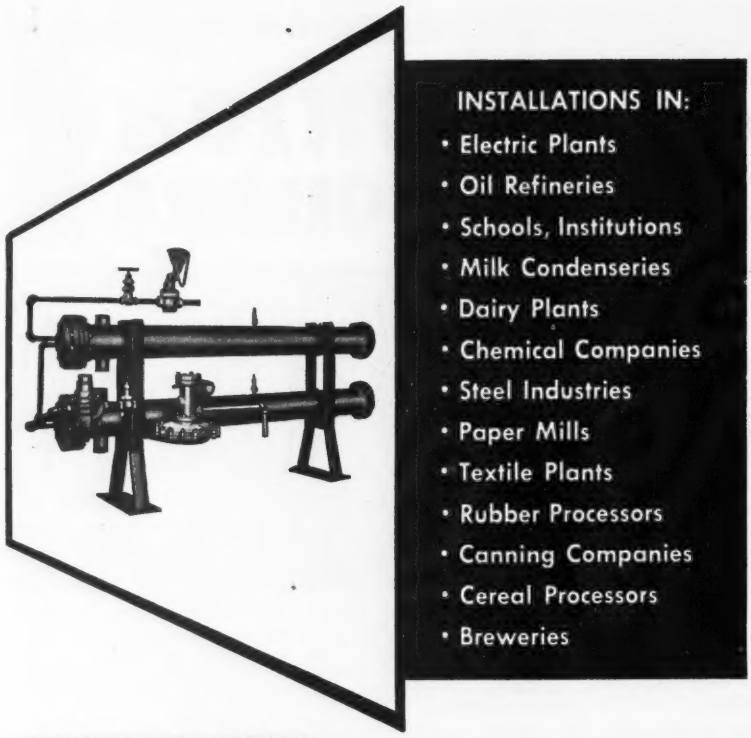
UNIVERSAL, fire tube boilers sizes to 300 H. P. (1) for brick setting — (2) steel cased refractory lined in self-contained units — (3) either of these styles with water cooled furnaces.



LITTLE GIANT, a shop assembled unit combining pressure element and steel refractory lined furnace — one piece boiler shell — 9 sizes 10 to 75 H.P. for 100 or 150 lb. W.S.P.



KD-TYPE, a knocked-down cross drum type boiler adapted from the Union Cross Drum Power Boiler design. No field welding required. 14 sizes from 2996 thru 34,119 sq. ft. E.D.R. S.H.B.I. steam rating.

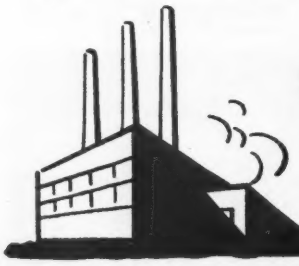


INSTALLATIONS IN:
- Electric Plants
- Oil Refineries
- Schools, Institutions
- Milk Condenseries
- Dairy Plants
- Chemical Companies
- Steel Industries
- Paper Mills
- Textile Plants
- Rubber Processors
- Canning Companies
- Cereal Processors
- Breweries

HENSZEY ***Continuous Blowdown***

Look at the wide variety of industries that take advantage of the low cost power and clean steam that a Henszey Continuous Blowdown System can provide. That partial list is a typical cross section of American industry. Which means that you, too, should consider a Henszey system in conjunction with your present or planned boilers.

The Henszey system keeps boiler water concentration within safe margins — preventing foaming, priming, carryover, and the formation of sludge and scale (with proper chemical treatment). All this is accomplished continuously, automatically, and WITHOUT the heat loss of ordinary blowdown.



Contact your nearest Henszey representative or write to

HENSZEY COMPANY

Department C5 Watertown, Wis.

HENSZEY

CONTINUOUS BLOWDOWN
***and* BOILER PLANT SPECIALTIES**

Boiler Feed Regulators • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves
also MILK EVAPORATORS and PREHEATERS

management from those daily exposed to actual shop conditions.

2. Persuades the union to supply a time-study man to work with company experts.

3. Analyzes jobs manned by employees who have been agreed upon by company and union as being representative with respect to skill and stamina.

4. Submits the proposed rate changes to top union officials before they are announced to the rank and file. As far as practical, their criticism and suggestions should be adopted.

5. Representatives of the union as well as of the company explain the entire plan to the employees—in question-and-answer meetings if possible, but at least always in clearly written brief brochures or leaflets. Through his foreman, every employee learns exactly how the revised wage incentive plan will affect him.

Where no plan exists and one is contemplated, Mr. Croft advocates that the union or—if no union exists—a representative committee of employees should be advised of and consulted on the principles and details of the proposed incentive program.

Ashton Valve Co. Expands

ANNOUNCEMENT HAS BEEN MADE that the Ashton Valve Co. has acquired the valve division of the Lombard Governor Corp. the products of which consist of relief valves applicable for use by the U. S. Navy and Maritime Commission. petroleum. chemical and general industries. These are built in sizes varying from ⅜ in. to 8 in.

From now on the line of valves will be manufactured at the Ashton main plant in Cambridge, Mass. and will be subject to rigid tests and inspection before placed on the market.

Ashton has secured the experienced services of John F. String, formerly Valve Sales Manager of the Lombard Governor Corp. and of the Everlasting Valve Co.

Hagan Corp. Gives Training to Chinese

PENG HUNG, a technically-trained Chinese engineer, has recently arrived for a special training course in combustion control under Hagan Corporation engineers in Pittsburgh, Pa.

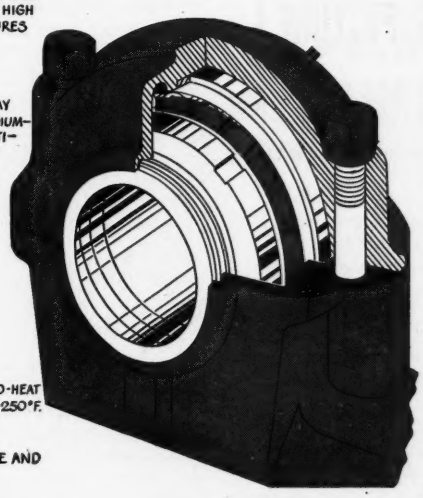
This program of training was initiated in 1944 as a war measure in the Pacific area and is now directed toward assisting the rehabilitation and industrialization of China. It carries the endorsement of the United States government through the State Department and of the Chinese government through the Chinese Supply Commission and the National Resources Commission of China.

At present about 1000 specially selected, English-speaking Chinese are in this country studying the problems of railroads, petroleum, aviation, communications, roadbuilding, power, chemistry, textiles, electrical manufacturing, machine tools, shipbuilding, agriculture and other industries.

Because of its having pioneered work in 1918 in developing the first air-operated automatic combustion control for industry, the Hagan Corp.

STANDARD ENGINEERS NOTEBOOK

CALOL RPM


CALOL S.A. GREASE ASSURES GOOD LUBRICATION IN HIGH AMBIENT TEMPERATURES
CALOL S.A. GREASE MAY BE USED ON LOW-, MEDIUM- AND HIGH-SPEED ANTI-FRICTION AND PLAIN BEARINGS
WITHSTANDS RADIATED-HEAT TEMPERATURES OVER 250°F.
MINIMIZES DRIPPAGE AND LEAKAGE TROUBLE

New grease lubricates in extra hot conditions

Developed especially for bearings that must operate in radiated heat, new Calol S. A. (sodium aluminum) Grease has proved satisfactory in temperatures over 250° F. It has been tested by many operators on working machines in the field. In addition, it was given a series of tests in the Navy Ball Bearing Machine, operated at 10,000 rpm, with bearing temperatures maintained at a high degree.

Calol S. A. Grease is made from a special type base and selected oils that give it high heat-resistant qualities. In use, these qualities assure minimum drippage or leakage from bearings.

Although Calol S. A. Grease is ideal in a multiplicity of services, it is specifically adapted to the lubrication of low, medium and high speed anti-friction bearings used in all types of machines.

Made in three grades, 00, 0, and 1, by Standard of California, Calol S. A. Grease is available in 35-, 108- and 420-pound containers.

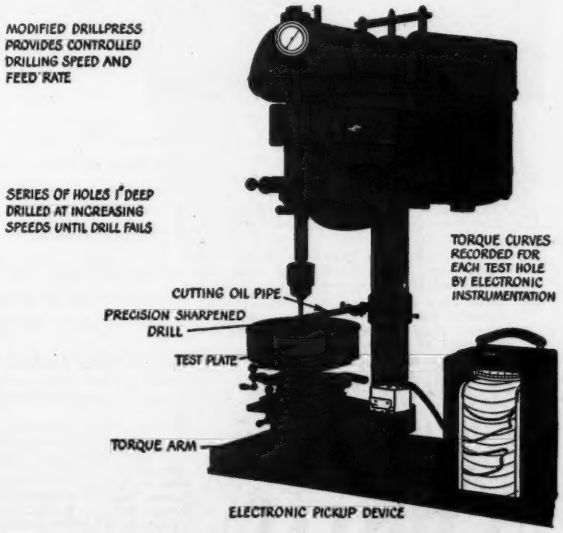
All Calol Cutting Fluids get breakdown test

To make sure that every Calol Cutting and Soluble Oil will preserve machine tools for maximum periods and produce the finest possible finish on the work for which it is recommended, Standard of California scientists developed the Drilling Torque Tester.

A modified drillpress, the speed and feed rate of which can be controlled, is used. For each test, a series of holes 1 inch deep is drilled with a precision-sharpened drill into a test plate. A constant drill feed is maintained with speeds increasing 100 rpm for each test hole. An electronic device records the torque curve for each hole.

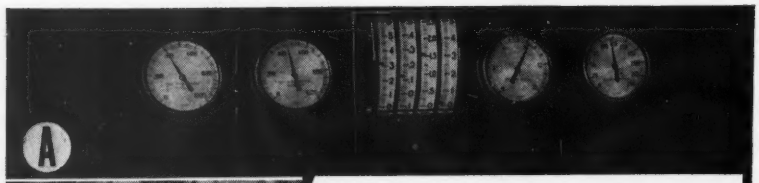
The oil being tested is applied to the tool and work by a regular flow pipe. Oils are rated in terms of the speed at which drill failure occurs. Drill failure is indicated by a peak on the torque curve.

Every Calol Cutting Oil and Soluble Oil is evaluated in this "breakdown" test. For complete information about Calol Cutting Fluids write for the free booklet on that subject.

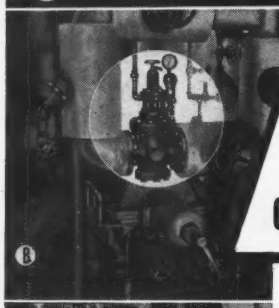

MODIFIED DRILLPRESS PROVIDES CONTROLLED DRILLING SPEED AND FEED RATE
SERIES OF HOLES 1" DEEP DRILLED AT INCREASING SPEEDS UNTIL DRILL FAILS
TORQUE CURVES RECORDED FOR EACH TEST HOLE BY ELECTRONIC INSTRUMENTATION
CUTTING OIL PIPE
PRECISION SHARPENED DRILL
TEST PLATE
TORQUE ARM
ELECTRONIC PICKUP DEVICE

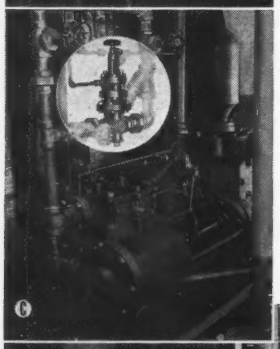
For additional information and the name of your nearest Distributor, write Standard of California, 225 Bush Street, San Francisco 20, Calif.; The California Oil Company, 30 Rockefeller Plaza, New York 20, N. Y.; The California Company, 17th and Stout Streets, Denver 1, Col.; Standard Oil Company of Texas, El Paso, Texas.

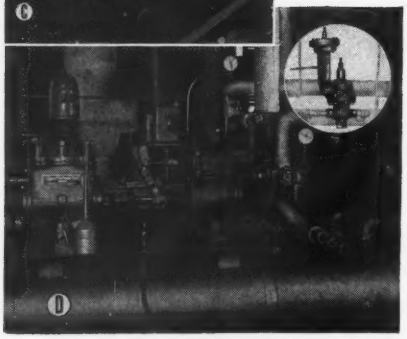
FOR EVERY JOB A **STANDARD OF CALIFORNIA** TEST-PROVED PRODUCT



DOES YOUR OPERATING BOARD SHOW THIS PICTURE of AUTOMATIC CONTROL?







These operating board gages in the power plant of Beattie Manufacturing Company, makers of Axminster, Velvet and Wilton Rugs, Little Falls, N. J., tell a real "behind-the-scenes" story of steam power automatically controlled to extremely close limits regardless of load variations.

The second gage, recording boiler feed water pressure shows 470 lbs. set pressure maintained by a LESLIE Pump Governor which completely controls operation of turbine-driven feed pump. Third gage indicates efficient operation of a LESLIE Pressure Controller working instantly to make up any deficiencies in low pressure heating system. This make-up steam is taken from 125-lb. system and controlled so that pressure is held accurately at 9 psi.

The steady needle pointer on fourth gage shows process steam reduced to 120-lbs. by a LESLIE Pressure Controller from 400-lbs. initial boiler pressure, shown on first gage.

The real reason for this extreme accuracy of control lies in LESLIE'S policy of only building better regulators — giving extra features such as stellited valve seats, surface hardened stainless steel valves and heat-treated stainless steel cylinder liners with highly ground finish—*all as standard equipment which guarantees positive dead-end service and close regulation.*

Investigate today the savings which LESLIE Regulators make possible. Write for LESLIE Catalog of Engineering Data.

LESLIE

(A) Section of Operating Board in Power Plant of Beattie Manufacturing Co.

(B) LESLIE Class PTH Pump Governor on Turbine Driven Feed Pump maintaining constant feed water pressure to boilers.

(C) LESLIE Class PRH Pump Governor on Reciprocating Pump maintaining constant water pressure in Beattie Dye House.

(D) LESLIE Class LTCO Temperature Regulator in Beattie boiler room controlling temperature of fuel oil to burners and holding within ±2° under all load conditions.

LESLIE CO.

257 Grant Avenue • Lyndhurst, N. J.

Look for "LESLIE Regulators" in your classified telephone directory in these cities, for LESLIE factory-trained engineers to help you with your regulation problems:

Baltimore, Md.	Milwaukee, Wis.	San Francisco, Cal.
Boston, Mass.	Montreal, Que., Can.	Savannah, Ga.
Bridgeport, Conn.	New Orleans, La.	Seattle, Wash.
Chicago, Ill.	New York, N. Y.	St. Louis, Mo.
Cleveland, Ohio	Philadelphia, Pa.	Syracuse, N. Y.
Dallas, Tex.	Pittsburgh, Pa.	Toronto, Ont., Can.
Detroit, Mich.	Portland, Ore.	Troy, N. Y.
Greenville, S. C.	Providence, R. I.	Tulsa, Okla.
Houston, Tex.	Richmond, Va.	Vancouver, B.C., Can.
Kansas City, Mo.	Rochester, N. Y.	Wilkes-Barre, Pa.
Los Angeles, Cal.	Rutherford, N. J.	Youngstown, Ohio
Louisville, Ky.	San Antonio, Tex.	

ESTABLISHED 1900

LESLIE CO.

PRESSURE REDUCING VALVES · PUMP GOVERNORS · PRESSURE CONTROLLERS
TEMPERATURE REGULATORS · SELF CLEANING STRAINERS · LESLIE-TYFON WHISTLES

was asked to aid in the training of Mr. Peng—a step which has steadily been extended to most industrial and power plants as well as to the marine field. All expenses of students taking these courses, including housing, are paid so that no firm giving training is put to any expense except for time. Students draw $150 per month for subsistence, paying the rest from their own pockets.

Heat Reclaimer Corp. Expands

THE HEAT RECLAIMER CORP., 6 N. Michigan Ave., Chicago, Ill., under a special license agreement recently consummated, will manufacture and sell the Stout No-Vent Boiler Return System, previously manufactured in St. Louis by David Stout & Sons. The same personnel that has sold and serviced the Stout products in the past will be retained by the Heat Reclaimer Corporation for this same service. Other Stout heat exchange equipment will also be distributed exclusively by the Heat Reclaimer Corp., but these products will continue to be manufactured in St. Louis as heretofore.

Perfex Forms Canadian Subsidiary

THE PERFEX CORP., Milwaukee, has announced the formation of a Canadian subsidiary to be known as Perfex Controls, Limited, 73 Simcoe Street, Toronto 1, Ontario.

The officers of the newly formed subsidiary are J. K. Luthe, president; C. E. Lewis, vice-president; E. G. Spall, vice-president; V. R. Tate, secretary; A. L. Eastcott, treasurer; and J. F. Van Lane, assistant treasurer.

New Fluid Measurement Handbook

A COMPLETE yet concise treatment of fluid measurement, including related factors, equipment, equations and computations in terms of steam, water, oil, and gas flow, is offered in a new volume, The Flow Meter Engineering Handbook, compiled and edited by Louis Gess and R. D. Irwin, flow meter engineering department, Brown Instrument Company division of Minneapolis-Honeywell Regulator Company. The Flow Meter Engineering Handbook is being published by Brown Instrument Co., Philadelphia. It is priced at $2.50 a copy.

Honors Pioneers

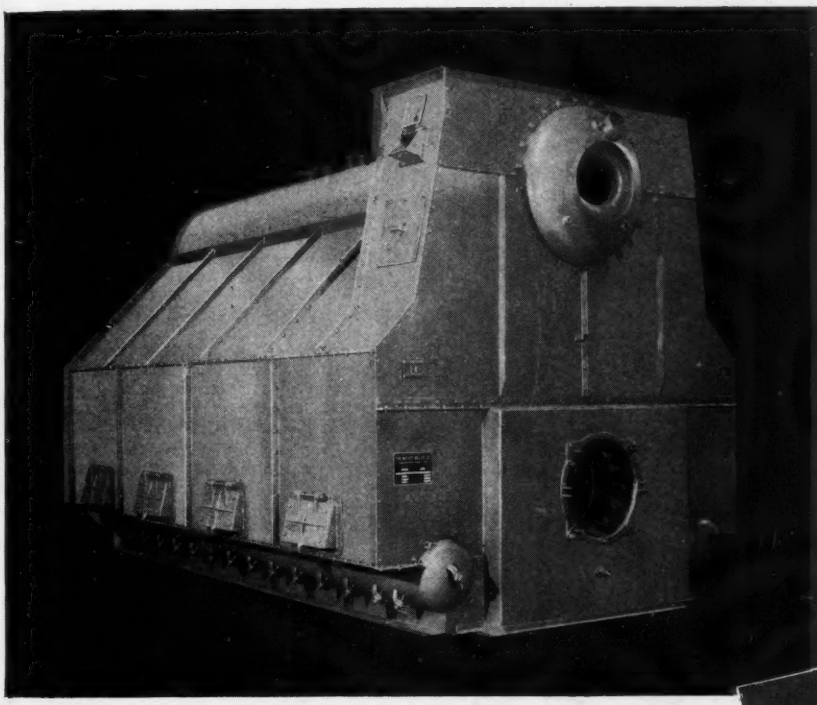
GREAT BARRINGTON in the Berkshire mountains of Western Mass., first community in America to be lighted by alternating current electricity, observed the 60th anniversary of the event March 23, 1946, when Governor Maurice J. Tobin unveiled a plaque commemorating the achievement of William Stanley and George Westinghouse.

On March 20, 1886, young Stanley, who for nearly a year had labored in an abandoned rubber mill on the edge of town creating, assembling and testing his equipment, closed a master switch that sent electricity along nearly a mile of copper wire to the center of the town.

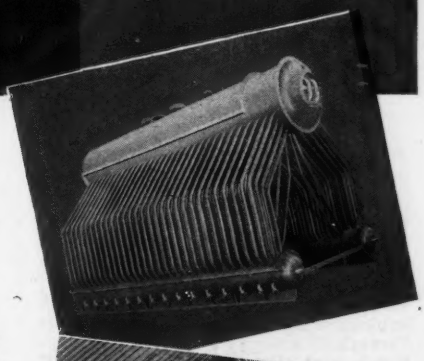
PACKAGE POWER EFFICIENCY FOR YOUR PLANT

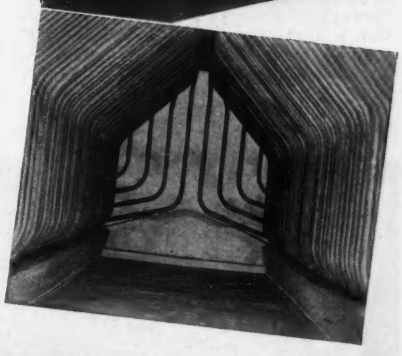
WITH WICKES

CROWN TYPE-A BOILERS



- Specially designed so that each furnace wall is a separate steam generator as well as an integral part of boiler unit.
- Drums fully protected against intense furnace heat.
- Front and rear refractory surfaces protected with waterwalls.
- No complicated headers or circulating tubes to require frequent maintenance and repair.
- Conserve head room and floor space.





WICKES PACKAGE CROWN TYPE-A BOILERS typify the combined engineering knowledge and expert workmanship that for nearly a century have distinguished all Wickes products. Patterned after our line of large Crown Type-A Boilers, the Package Unit is engineered for pressures up to 500 p.s.i. and for capacities of 20 to 250 nominal horsepower. Compact, efficient, they are produced as a steel-cased package unit and are shipped ready for operation with a minimum of installation problems. Send us your boiler requirements and our engineers will be glad to determine how Wickes Crown Type-A or other Wickes boilers can increase power efficiency in your plant.

SALES OFFICES • Detroit, Mich.; Chicago, Ill.; New York, N. Y.; Milwaukee, Wisc.; Pittsburgh, Pa.; San Jose, Calif.; Tulsa, Okla.; Fort Worth, Texas; Mexico City, Mexico; Saginaw, Mich.; Portland, Ore.; Boston, Mass.; Indianapolis, Ind.; Baltimore, Md.; San Francisco, California.

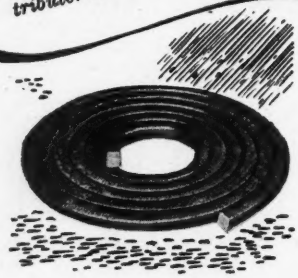
THE WICKES BOILER CO.

SAGINAW, MICHIGAN, U.S.A. • RECOGNIZED QUALITY SINCE 1854

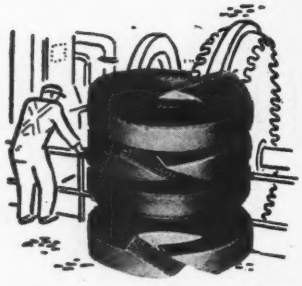
3 Sealing Problems Solved—

These three packings are representative of the extra values built into each product in the complete Belmont line. For every service . . . steam, water, oil, gas, air, acids, alkalis, ammonia . . . your Belmont Distributor has the right packing.

For high pressure steam rods Belmont 30 High Pressure Asbestos Packing has center block pleated on itself, accordion-fashion, at approx. 90° angle with rod. High resiliency and flexibility, extra take-up, extra "edge wear" if packing wears to block.



For "boiling in oil" Belmont 189 Hot Oil Asbestos Packing has extra resistance to penetration. Long-fibre asbestos yarn is firmly braided, each strand treated with a special compound so that saturation and penetration are minimized.



Hollow Center Packing, Belmont 19 provides a point of least resistance for expansion and contraction. Packing "breathes" toward the hole, so friction is kept at minimum point created by the working pressure itself. Light-weight—economical.

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

IN THE BLUE-AND-ORANGE BOX

There is a Belmont Packing for Every Service

Belmont distributors are located in every large industrial center, ready to give you prompt delivery from local stocks.

6 New Folders
Write us for new folders on Belmont Centrifugal and Rotary Pump Packings, Flax Packings, Hollow Center Packings, Oil and Gasoline Packings, Rod Packings, Sheet Packings.

THE BELMONT PACKING AND RUBBER CO.

Butler and Sepviva Streets

Philadelphia 37, Pa.

Scores of light bulbs flickered, then glowed brightly along the street and in stores and offices. The significance of the event, historians noted, was that electricity had overcome the obstacle of distance; that steam power plants could be located near coal mines to convert the stored energy of coal into electricity which could be transmitted to cities many miles away; that water power could be used to supply electricity to communities far from the source of power.

It was a night of triumph for George Westinghouse, and the centennial of whose birth is being observed this year. At 39 he had already invented the air brake, established several new companies and in the decade between 1890 and 1900 further proved his alternating current theories by lighting the Chicago World's Fair and harnessing Niagara Falls.

Diesel Caravans

Two CARAVANS left Detroit Diesel Engine Division, General Motors Corp., on Mar. 1 to conduct conferences on service and maintenance in all parts of the country. After a joint stop at the Western Machinery Co., General Motors distributors in St. Louis, Mo., the two groups will separate, one going to the West coast and one traveling through the south and east, visiting distributors of the Company's diesel industrial and marine engines. Their itinerary will cover a total of over 12,000 miles.

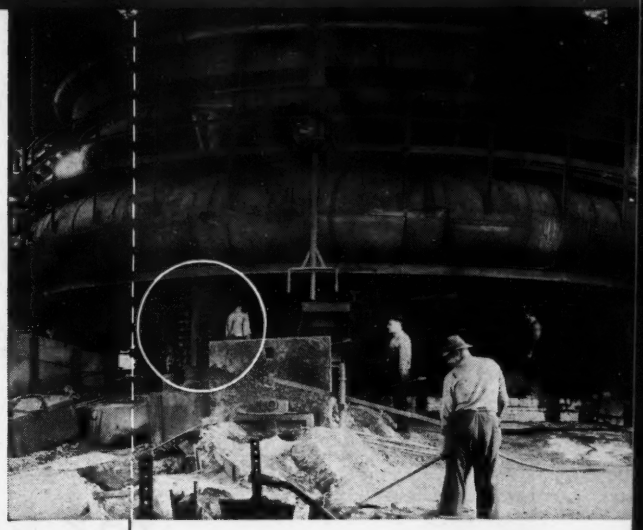
The purpose of the conferences will be to emphasize, through prepared charts, films, slides and work on a live engine, correct methods of maintenance and repair. Both groups will conduct one conference each week which will be attended by representatives from several distributors in a radius of 50 to 300 miles.

The Daniel Adamson & Co., Ltd., of Dukinfield, Cheshire, England, will manufacture the complete heat transfer equipment line of the Alco Products Division, American Locomotive Co., it was announced recently. Under the terms of the affiliation, the English company will establish a division to produce Alco Products equipment. Alco Products Division of American Locomotive will do all engineering and designing.

The International Nickel Co., Inc., announces the opening of the Empire State Technical Section of its Development and Research Division as of April 1. It will be located in the Genesee Valley Trust Building, Exchange and Broad Streets, Rochester 4, New York, and will furnish technical information and assistance to industry in the State of New York excluding New York City, the Albany area, and the Hudson River Valley. Gilbert L. Cox, Metallurgical and Chemical Engineer, will be in charge. He has been associated with International Nickel since 1931, serving in various capacities in its Development and Research Division.

Foster Wheeler Corp. announces election of H. S. Brown as chairman of the board to succeed his brother, the late J. J. Brown. Mr. Brown will continue as president of the corporation in addition to his new post.

DOWELL



Full blast!

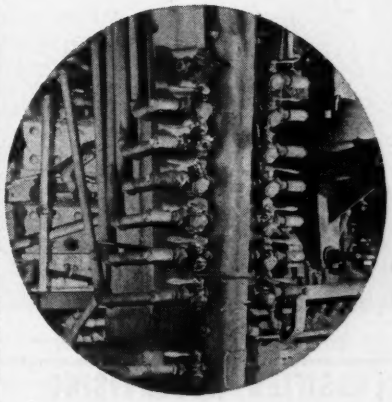
while chemicals clean

the cooling system

Steel plant operators are finding that the Dowell method of *chemically dissolving* accumulated scale is the modern, rapid way to clean hearth plate cooling coils without shutting down production.

Dowell chemically cleans cooling stack plates, bosh plates, gas scrubbers, boilers, dust precipitators, condensers, filter beds and water lines above or below ground . . . also steam generating equipment, furnace equipment, mills, cooling machinery, locomotive equipment, by-product coke plants and heating systems.

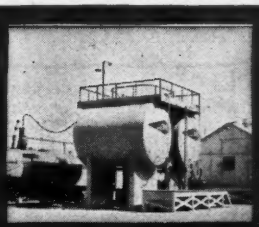
Dowell specialists offer a complete cleaning service to steel mills and industries of every sort. They chemically analyze samples of deposits taken from *your* equipment, prepare the proper solvents and bring with them all treating equipment needed. Call the nearest Dowell office for a free estimate. Ask for "More Power to America's Industry"—new color booklet describing Dowell Chemical Cleaning Service.



DOWELL INCORPORATED, TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company

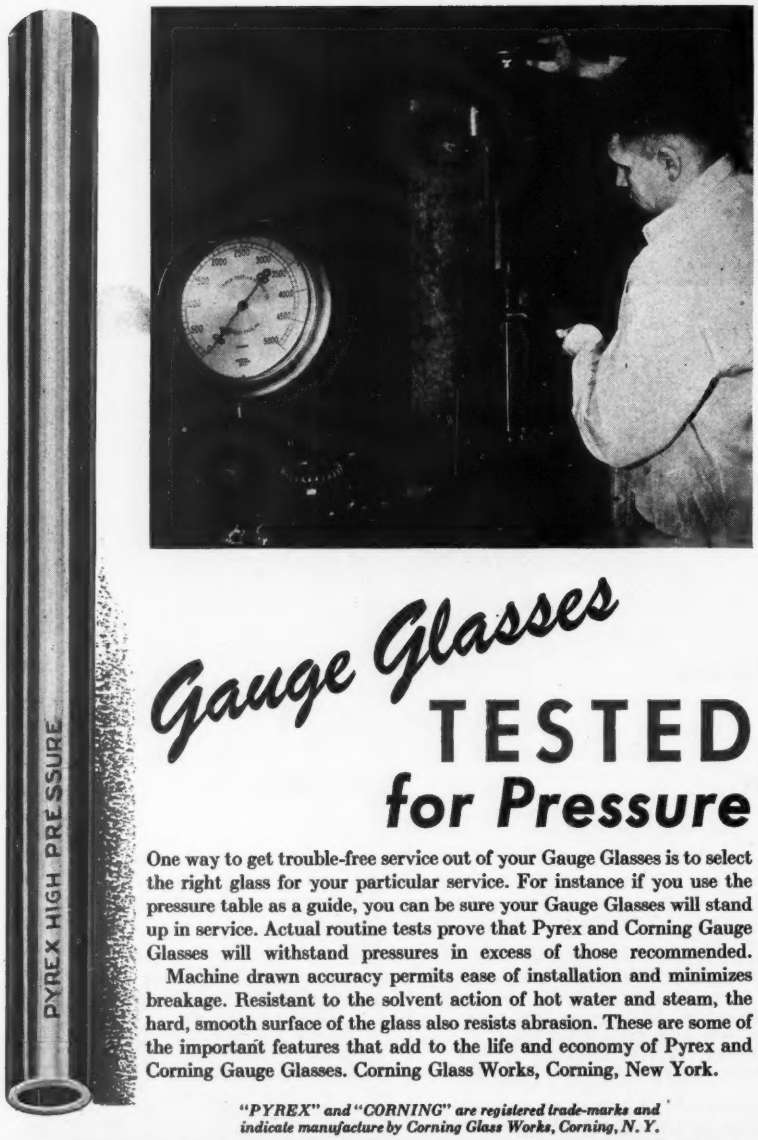
New York • Philadelphia • Baltimore • Buffalo • Cincinnati • Cleveland • Chicago • Detroit
St. Louis • Houston • Kansas City • Wichita • Pittsburgh • Mt. Pleasant, Mich. • Salem, Ill.
Long Beach, Casper: Dowell Affiliate—International Cementers, Inc.

SPECIALISTS IN CHEMICAL CLEANING SERVICE



DOWELL

FOR INDUSTRIAL CHEMICAL SERVICE



Gauge Glasses TESTED for Pressure

One way to get trouble-free service out of your Gauge Glasses is to select the right glass for your particular service. For instance if you use the pressure table as a guide, you can be sure your Gauge Glasses will stand up in service. Actual routine tests prove that Pyrex and Corning Gauge Glasses will withstand pressures in excess of those recommended.

Machine drawn accuracy permits ease of installation and minimizes breakage. Resistant to the solvent action of hot water and steam, the hard, smooth surface of the glass also resists abrasion. These are some of the important features that add to the life and economy of Pyrex and Corning Gauge Glasses. Corning Glass Works, Corning, New York.

"PYREX" and "CORNING" are registered trade-marks and indicate manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York — Pyrex Gauge Glasses

David McCulloch, executive vice-president, was named chairman of the executive committee to succeed H. S. Brown. All other officers were re-elected.

Detrex Corp., Detroit, has just announced the promotion of R. W. Pflug to national accounts manager. Mr. Pflug, formerly central regional manager, started in the engineering department of Detrex Corp. in April of 1935. From the engineering department he was transferred to sales as service engineer on national accounts, and then was central regional manager until his recent appointment.

The Perfex Corp., Milwaukee, announces the appointment of Gil A. Churchill as manager of its Chicago Branch, of B. F. "Dutch" Werb as manager of its newly-formed Milwaukee Branch. Mr. Churchill's association with the controls industry dates back to 1925, and since that time he has worked in almost every phase of the industry . . . manufacturing, service, and sales. Mr. Werb is a veteran of twenty years' experience in the controls industry. Before joining Perfex as a sales engineer in 1940, he held various positions with Underwriters' Laboratories, Mercoid Corp., National Radiator Corp., and Oil Devices.

The Perfex Corp., of Milwaukee, Wis., has recently purchased a manufacturing plant at 710 South Third Street, which the corporation operated during the war as its Optical Division. The building which contains 63,000 sq ft of floor space, will be used to increase the corporation's production.

Blaw-Knox Co., of Pittsburgh, Pa., has appointed the Delavan Engineering Co., of Des Moines, Iowa, to handle the power piping division account representing Blaw-Knox in the sale of pre-fabricated piping, functional hangers, and vibration eliminators in the states of Iowa and Nebraska, and also in Rock Island County, Ill.

• **Ampco Metal, Inc.,** Milwaukee, Wis., has announced the appointment of a number of managers of specialties sales. J. R. G. Harris becomes manager, resistance welding sales and is responsible for the sale of resistance welding electrodes and alloys; D. S. Goebel has been appointed manager, mill products sales and will promote the purchases of continuous castings and mill products such as extruded bronze rod, hollow rod and shapes; G. E. McCulloch is now manager of safety tool sales; F. C. Hawks has joined the sales staff as field engineer—mill products, and will be active in the promotion of mill products sales. He will make his headquarters in Chicago.

The Brown Instrument Co. division of Minneapolis-Honeywell Regulator Co. has opened a sales and service office at 16 State Street, Rochester, N. Y., under the supervision of Gerald L. Britton. O. J. Richardson has been appointed industrial manager of the division at Detroit, Mich. Mr. Richardson has been with the Company for the past 10 years, having served as sales engineer and in other capacities at the Philadelphia com-

CLASSIFIED ADVERTISING

HELP WANTED

POWER PLANT ENGINEERING AND construction company located in midwestern city have an opening for a competent power plant engineer having specific experience with high pressure piping design and detailing and with general power plant construction practice. Excellent opportunity for competent man who is willing to apply himself. Man should preferably be technical graduate with specific experience in this field. Good salary will be paid. Employment permanent. Please send detailed description of education and experience. Expenses for personal interview will be paid. Address Box 1509, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Illinois.

Power Plant Superintendent

Power plant superintendent under 45 years of age, experienced in high-pressure plant operation, maintenance, and labor relations. Permanent connection, company in middle-west, residence in middle-size industrial community, salary $6,000. Write education, experience, references. Address Box 1508, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Illinois.

Mechanical Engineers

Large engineering and construction organization desires Mechanical Engineers with substantial experience in design and engineering of steam power plants. Applicants state experience, education, age and salary. Write Box 1510, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Illinois.

The importance of specialized shop facilities for pipe fabrication is demonstrated convincingly by this Grinnell-developed extruding machine.

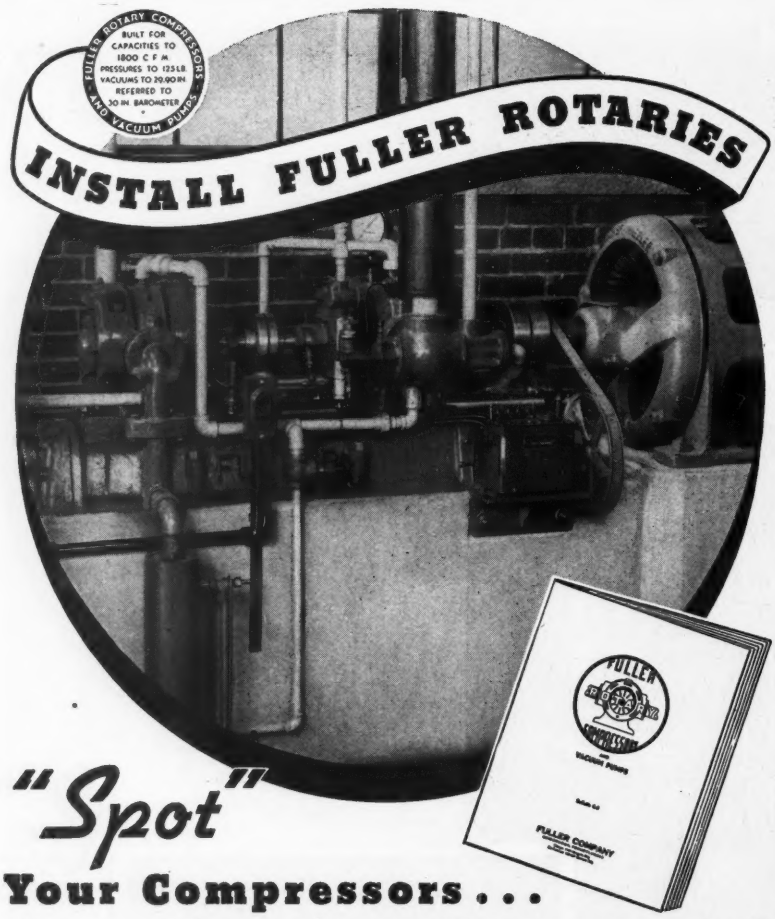
The accurately extruded nozzles permit easier pipe erection in the field by making each weld a plain circumferential butt weld. The smooth contours, accurate positioning of the nozzle and the uniform wall thickness are possible only because of this type of shop equipment designed for the job.

Make use of Grinnell's engineering, metallurgical research and pipe fabrication facilities when specifications call for shop fabricated piping.

GRINNELL COMPANY, INC.
Executive Offices, Providence, R. I.
Pipe Fabrication Plants:
Providence, R. I. Atlanta, Ga. Warren, Ohio

GRINNELL

WHENEVER **PIPING** IS INVOLVED


FULLER ROTARY COMPRESSORS AND VACUUM PUMPS
BUILT FOR CAPACITIES TO 1800 C F M. PRESSURES TO 125 LB. VACUUMS TO 29.90 IN. REFERRED TO 30 IN. BAROMETER
INSTALL FULLER ROTARIES
FULLER
FULLER COMPANY

"Spot"

Your Compressors . . .
Air . . . Where and When Needed

This is the fifth and last of a series in which we have endeavored to set forth some of the outstanding qualifications and advantages of the Fuller Rotary Compressor. Necessarily our story in these advertisements had to be very brief.

We should welcome the opportunity to discuss advantages for your plant to: *"Spot your compressors . . . have your air when, where and as you need it."* We have every reason to believe you will profit by such an installation, as many others have done in the past few years.

The installation shown above proves our point . . . a two-stage compressor which was operated 23 hours per day for four years, and not one cent was spent for repairs or replacements.

Bulletin C-5 illustrates and describes these machines. It's yours for the asking.

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA

Chicago 3 · 1144 Marquette Bldg.
San Francisco 4 · 421 Chancery Bldg.
Washington 5, D. C. · 618 Colorado Bldg.

C-113

FULLER
PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

pany's Cincinnati, Buffalo and Pittsburgh branches. George W. Brown has been appointed industrial manager of the Cincinnati office. Mr. Brown has been with the Philadelphia industrial division for the past nine years as sales engineer in Chicago, Louisville, Philadelphia and New York.

American Engineering Co., Philadelphia, announces the appointment of Roy A. Stipp, Blue Building, Greenville, S. C., as the company's sales representative in the Carolinas and eastern Tennessee.

W. S. Mounce, formerly senior metallurgist with the Hamilton Standard Propellers Division, United Aircraft Corp., has joined the Development and Research Division of The International Nickel Co., Inc. His headquarters will be at the New England Technical Section of the Division at 75 Pearl Street, Hartford, Conn.

Announcement has been made by Hahn Engineering Co., 30 Church St., New York 7, N. Y., of the formation of Hahn Equipment Corp. of the same address with Eugene Hahn as President and Robert Gordon as Secretary-Treasurer. Products of the corporation will be pipe-line or pneumatic ash and fly-ash conveyors, cast-iron sectional ash tanks, lined ash hoppers, coal bunkers, silos, and similar equipment as well as mechanical soot blowers for fire-tube boilers.

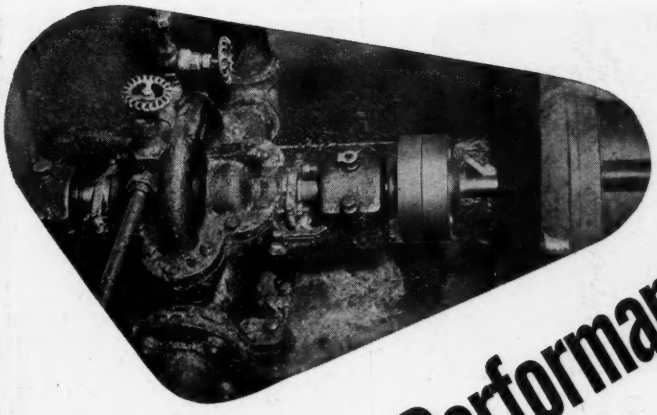
MANUFACTURERS' *Personals*

The Sterling Engine Co. of Buffalo, N. Y., recently announced the election of Robert E. Dillon to the Board of Directors. With a broad experience in industrial and financial circles, Mr. Dillon will be in a position to contribute much toward the continued success of Sterling Engine Co's. postwar plans.

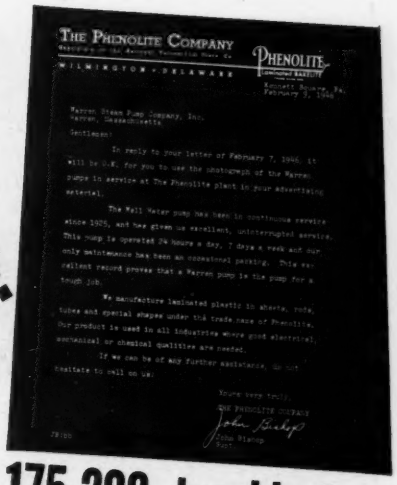
Arthur D. Little, Inc., Cambridge, Mass., has recently secured the services of five men formerly engaged in war research projects. These are: Dr. W. H. Avery, physical chemist, formerly with the Allegany Ballistics Laboratory; Dr. Richard Handrick, organic chemist, formerly at the University of Pennsylvania; Winslow A. Sawyer, mechanical engineer, was with the Army Ordnance Department; Raymond M. Hainer, physical chemist, formerly at Brown University; and Richard F. Messing, chemical engineer, who served with the Office of Scientific Research and Development.

Worthington Pump and Machinery Corp. announces the appointment of Andrew S. Ormsby as director of Industrial Relations. He was formerly in charge of industrial relations of the Bendix Aviation Co.

In line with the Baldwin Locomotive Works plan for sales expansion, Roland C. Disney has been appointed manager of the eastern district of the



Can you top this Performance?


THE PHENOLITE COMPANY

PHENOLITE

WILMINGTON · DELAWARE

Kennett Square, Pa.
February 9, 1946

Warren Steam Pump Company, Inc.
Warren, Massachusetts

Gentlemen:

In reply to your letter of February 7, 1946, it will be O.K. for you to use the photograph of the Warren pumps in service at The Phenolite plant in your advertising material.

The Well Water pump has been in continuous service since 1925, and has given us excellent, uninterrupted service. This pump is operated 24 hours a day, 7 days a week and our only maintenance has been an occasional packing. This excellent record proves that a Warren pump is the pump for a tough job.

We manufacture laminated plastic in sheets, rods, tubes and special shapes under the trade name of Phenolite. Our product is used in all industries where good electrical, mechanical or chemical qualities are needed.

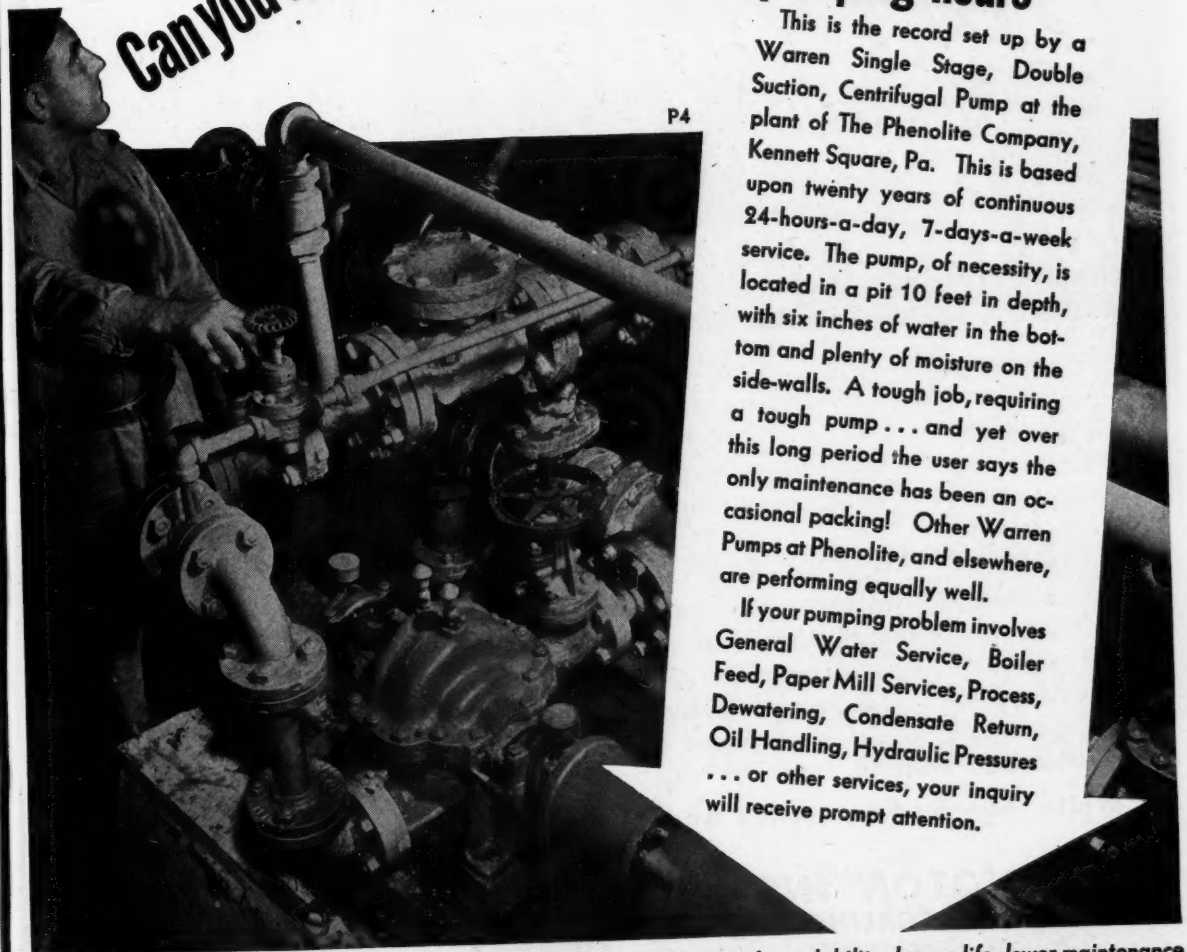
If we can be of any further assistance, do not hesitate to call on us.

Yours very truly,
THE PHENOLITE COMPANY
John Bishop
John Bishop
Asst.

175,200 trouble-free pumping hours

This is the record set up by a Warren Single Stage, Double Suction, Centrifugal Pump at the plant of The Phenolite Company, Kennett Square, Pa. This is based upon twenty years of continuous 24-hours-a-day, 7-days-a-week service. The pump, of necessity, is located in a pit 10 feet in depth, with six inches of water in the bottom and plenty of moisture on the side-walls. A tough job, requiring a tough pump . . . and yet over this long period the user says the only maintenance has been an occasional packing! Other Warren Pumps at Phenolite, and elsewhere, are performing equally well.

If your pumping problem involves General Water Service, Boiler Feed, Paper Mill Services, Process, Dewatering, Condensate Return, Oil Handling, Hydraulic Pressures . . . or other services, your inquiry will receive prompt attention.


P4

For greater dependability, longer life, lower maintenance

WARREN STEAM PUMP COMPANY, INC.
WARREN, MASS.

Atlanta Boston Chicago Cleveland Detroit Houston Hartford
Indianapolis Los Angeles Minneapolis New Orleans New York
Philadelphia Pittsburgh Richmond San Francisco Seattle

WARREN PUMPS

FOR COMPLETELY AUTOMATIC AND DEPENDABLE VOLTAGE REGULATION

Burlington Synchrostat
(REG U.S. PAT. OFF.)
VOLTAGE REGULATOR

The Burlington Synchrostat, Type SR, Model SF, has proven to be the answer to the problem of voltage regulation in numerous installations. Its inherent sensitivity in following voltage changes makes it respond quickly and accurately in restoring generator voltage to normal.

SPECIAL FEATURES ARE:

Simplified control . . . rugged construction . . . simple installation . . . minimum maintenance . . . unaffected by reasonable vibration . . . automatic polarity reversal . . . rapid, positive response to maintain normal voltage.

Write today for full particulars **and** application data.

BURLINGTON INSTRUMENT CO.
1300 FOURTH STREET BURLINGTON, IOWA

PANEL INSTRUMENTS • VOLTAGE REGULATORS • AUTOMATIC SYNCHRONIZERS • FREQUENCY REGULATORS

Baldwin Locomotive Works, it was announced recently. Mr. Disney, who recently was relieved from Army duty with the rank of lieutenant colonel, will have his offices in the Broad Street Station Building in Philadelphia.

Dr. Richard C. Ulmer is now affiliated with E. F. Drew & Co., Inc., as technical director of the boiler-water treatment division. He has been placed in charge of the technical and research aspects of the various water treating problems. Prior to joining Drew, Dr. Ulmer was associated for 9 years with the chemical division of the research department of the Detroit Edison Co.

The Bristol Co., of Canada, Ltd., announces the appointment of Charles Webber as managing director of The Bristol Co. of Canada, Ltd. Mr. Webber will be in complete charge of the Canadian factory, which is located at 71-79 Duchess Street, Toronto 2, Ontario. He was formerly New York District Manager of The Bristol Co., and prior to that, was attached to The Bristol Co. at Waterbury, Conn. He has had extensive experience in the application of industrial instruments, particularly in the control field.

Leslie Co., Lyndhurst, N. J., announces several changes in officers as a result of elections held at recent annual meeting. S. Inglis Leslie, president of the company since 1926, has been elected chairman of the Board of Directors. John S. Leslie, who has been vice president and general manager since 1943, was elected president. J. M. Naab was reelected vice president and treasurer.

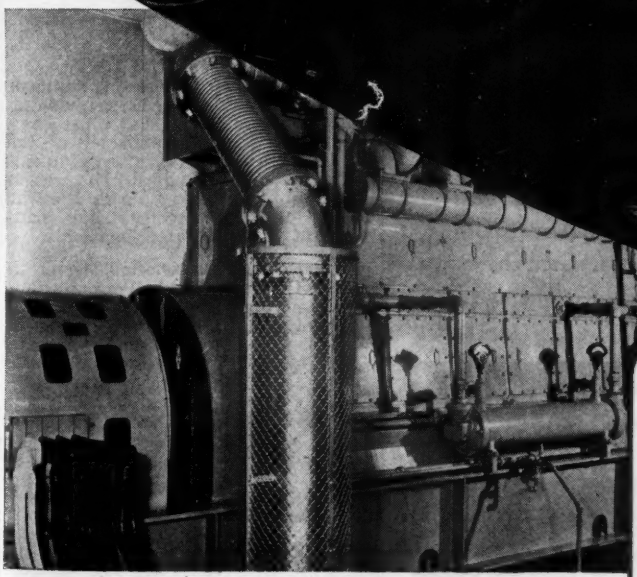
The Helicoid Gage Division, American Chain & Cable Co., Inc., announces the appointment of Midwest Controls Co. as its representative in Des Moines.

P. A. Alers has been appointed manager of the El Paso Texas Office of Worthington Pump and Machinery Corp. Alers is a graduate of the School of Mining Engineering at the University of Wyoming, and has been connected with Worthington since 1933.

A. P. Green Firebrick Co., Mexico, Mo., announces that, on May 1, Robert S. Green will become president of the firm, succeeding his father, Allen P. Green, who moves up to the post of chairman of the board. An executive committee of the board of directors has also been formed; it will consist of H. B. Plunkett, Lester J. Miller, A. D. Bond, Walter G. Staley and Allen P. Green, Jr.

H. A. Van Hala has been appointed district manager of the Cleveland branch office of The Bristol Co. Mr. Van Hala is being transferred from the Birmingham branch office where he has been district manager since 1935. In August 1922, Mr. Van Hala joined The Bristol Co. and until 1928 was assigned to the Boston and New York offices. He was then transferred to their Chicago office as sectional sales and service engineer where he remained until his appointment as manager of the Birmingham Branch office in 1935.

When you buy A *Superior* DIESEL you buy the finest

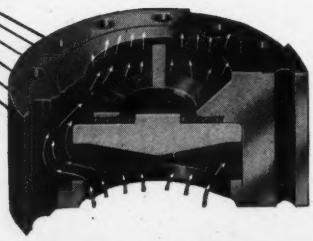


Superior Installation in Large Midwestern Public Utility

SUPERIOR DIESELS • MARINE • STATIONARY • LOCOMOTIVE

Superior **ENGINES**
Division of
THE NATIONAL SUPPLY CO.
Plant and General Sales Office:
Springfield, Ohio

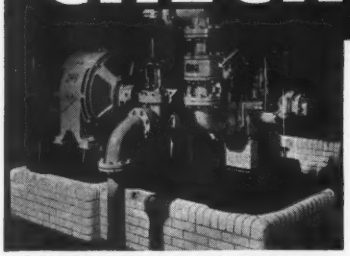
THIS NEW INFORMATIVE CATALOG WILL SOLVE YOUR "WATER HAMMER" *Problem!*



WILLIAMS-HAGER

FLANGED *Silent*

CHECK VALVES



A Williams-Hager Valve in the Metropolitan Life Building, New York.

- *Precision Engineered*
- *Economical*
- *Efficient*
- *Frictionless*
- *Tight Under Every Operating Condition or Pressure up to 6000 Lbs.*

Williams-Hager Flanged Silent Check Valves completely eliminate "Hammer" and "Bang" in the lines, provide uninterrupted constant flow of liquids.

Unlimited in size or application, from 1" to 20", built of materials to best suit the end use, Williams-Hager Flanged Silent Check Valves have been chosen for years as standard equipment in such exacting line uses as oil, gasoline, acids, water, chemicals, gas, air, salt water, brine, etc., regardless of temperature.

Write today for YOUR copy!

THE WILLIAMS GAUGE COMPANY

Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Pump Governors . . . Steam Traps Feed Water Regulators . . . Water Columns

3000 PENNSYLVANIA AVENUE · PITTSBURGH 12, PA.

P. J. Patton, Jr., was recently appointed regional manager by the Industrial Division, Ransome Machinery Co., Dunellen, N. J., with offices at 400 W. Madison St., Chicago. He is in charge of sales in the Middle Western area, including such industrial centers as Chicago, Detroit, Cleveland, and St. Louis, and will also assist in solving work and welding positioning equipment problems for Company distributors and their customers.

R. H. Porterfield has been appointed manager of a new branch office of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., in the New England district located at 1607 Industrial Trust Bldg., Providence, R. I., effective April 1. R. E. Scudder, who served as a U. S. Navy aviator during World War II, has been assigned to the new Providence branch as salesman. He joined Allis-Chalmers in August, 1945, upon his release from the Navy.

American Locomotive Co., has announced the appointment of Don Campbell to the public relations staff. Mr. Campbell was recently placed on inactive status after service as a senior lieutenant in the Pacific with the United States Navy.

Elmer Fern, Alaska and Northern Canada distributor for Brickseal Refractory Co. and XZIT Sales Co., was a recent visitor to Los Angeles. During his stay in Los Angeles, Mr. Fern spent considerable time at the company's headquarters on South Hoover Street. Mr. Fern handles distribution of XZIT Fire Scale and Soot Eradicator, Brickseal Refractory Coating and allied products in Alaskan Ports as well as principal towns of the interior and Northern Canada.

Worthington Pump & Machinery Corp. has recently named W. A. Finn, who has just been released from the U. S. Navy, as export manager. He succeeds George Gellhorn who has accepted a position of general manager of C. E. Halaby, one of Worthington's industrial machinery dealers in Columbia, S. A.

The Swartwout Co., Cleveland, Ohio, has announced the appointment of Royal L. Meyer as vice president in addition to his duties as chief engineer and assistant manager of the steam division. Another appointment is that of E. H. Bellard, who was in charge of purchasing during the war years, and now becomes sales manager of the Ventilator Division.

Charles D. LaFollette, vice-president of Corning Glass Works has announced that Howard E. Bahr, who became associated with Corning in 1934 is rejoining the company as manager of the public relations department after four years' military service. In his new position Mr. Bahr will be responsible for institutional advertising, company publicity, preparation and distribution of product exhibits and all general publicity of company operation for newspapers and the trade press.

Allis-Chalmers Mfg. Co., Milwaukee, Wis., has announced that A. W. Kremser has been named branch manager of the Davenport, Ia., office. The company also announced that Fred W. Bush has been promoted

"MAGIC-GRIP" FITS...even on Oversize or Undersize Shafts

"Magic-Grip" sheave needs no reaming, no filing, no sledge hammer on oversize shafts . . . grips undersize shafts without weave or wobble. And . . . you need no wheel puller to get it off.

The secret is in patented hub construction. "Magic-Grip" sheave comes fully assembled, with tapered split bushing of generous clearance for oversize shafts. Yet . . . when you tighten three cap screws, it locks on the shaft with the grip of a vise.

There's no struggle. Anyone can mount this sheave quickly, easily, accurately. It saves time, labor and money . . . can't damage shaft . . . prolongs bearing life because it mounts close, reduces overhang and vibration. And these advantages cost you nothing extra!

YOUR V-BELT DRIVE HEADQUARTERS

Call your nearest Allis-Chalmers office or dealer for TEXROPE "Magic-Grip" sheaves, Texsteel, Texdrive and Vari-Pitch sheaves, Speed Changers and famous TEXROPE Super-7 V-Belts. Full range of types and sizes. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

A 2036

ALLIS CHALMERS TEXROPE V-BELT DRIVES

HEAR THE BOSTON "POPS": *Every Saturday Evening, American Broadcasting Co.*

from assistant to the manager to the assistant manager of the electrical department of the Allis-Chalmers Mfg. Co. of Milwaukee. Another appointment is that of Frederick C. Ludington as manager of the firm's switchgear and control sections. Mr. Ludington joined Allis-Chalmers in 1923 and has been acting manager of these sections since the resignation last July of W. S. Edsall.

Upon returning from a five year term of military service, two years in the European Theatre, Lewis L. Dollinger, Jr., has again joined the Dollinger Corp. and was elected vice-president of the company. He will also act in a sales engineering capacity.

Announcement has recently been made by Leslie Co., Lyndhurst, N. J., of agents to handle industrial sales and services. H. F. Eastman Co., Boston, Mass., Eastern Massachusetts; Wilson Engineering and Sales Co., Cleveland, Ohio, North Central Ohio; Modern Electric and Engineering Co., Inc., Fremont, Neb., Eastern Nebraska and Western Iowa; Mooney Engineering Co., Kansas City, Mo., Eastern Kansas and Western Missouri.

General Electric Co. has announced the appointment of J. W. Brauns as manager of General Electric's Industrial Haulage Division. His principal responsibility is the sale, application and servicing of locomotives for use in industrial work, including Diesel electric and electric mine locomotives, as well as electric equipments for these locomotives. Mr. Brauns succeeds F. H. Craton who is now assistant manager of the Transportation Divisions.

Melvin C. Shaw has recently been named manager of the blower and compressor department at the Allis-Chalmers Mfg. Co., Milwaukee, Wis., to succeed John Avery, who has resigned to become president of a blower corporation in Indiana. Mr. Shaw joined Allis-Chalmers in 1914 and has been chief engineer of the department he will now head since 1935.

Announcement has been made by the American Engineering Co. of Philadelphia, of the following two additional sales representatives. Southern Equipment Co., 204 S. Fourth Street, Louisville, Ky., will represent the American Engineering Perfect Spread and Taylor Stokers in the greater Louisville area and central Kentucky. B & B Combustion Equipment Co., 4030 Chouteau Ave., St. Louis 10, Mo., will repreent the company in eastern Missouri and southern Illinois.

Socony-Vacuum Oil Co., Inc., has recently announced the appointment of Alverd C. Stutson as chief engineer of the technical division-industrial section of the company, and will succeed W. G. G. Godron, who has retired. Gerald J. Van Liew, staff engineer, has assumed the position as assistant chief engineer, formerly held by Mr. Stutson.

Iron Fireman Manufacturing Co. has recently announced that David H. Butler, a native of Elgin, Ill., and formerly a wartime War Production Board Administrator in Washington, has been appointed sales manager of the Toronto Factory Branch of Iron Fireman, and will handle the company's coal stoker and oil burner equipment.

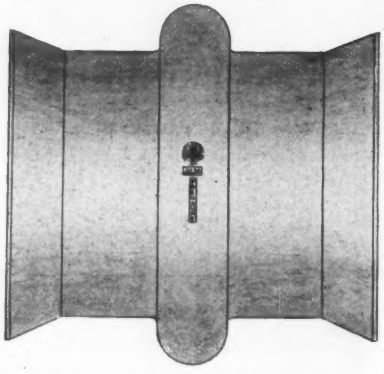
H. H. Barrows, Industrial Equipment Co. of Detroit, Mich., has been appointed sales representative for the De Laval Steam Turbine Co., of Trenton, N. J. The Industrial Equipment organization has been given the territory of the lower Michigan peninsula for the IMO Pump and Worm Gear Divisions of the De Laval Co.

Worthington Pump and Machinery Corp. has recently transferred James C. Barnaby, who has been consulting engineer to the general engineering staff at the Harrison Works as assistant director of research and development.

George A. Mattucci has been appointed as marine manager of the Great Lakes District for The Babcock & Wilcox Co. and will have his offices in the Guardian Building, Cleveland, Ohio.

J. S. Tatman has been elected chairman of the board and John Avery, president and general manager of Roots-Connersville Blower Corp., Connersville, Ind., one of the Dresser Industries. Mr. Tatman has been with Roots-Connersville since 1902 and is currently vice president of the Compressed Air & Gas Institute. Mr. Avery has been active in

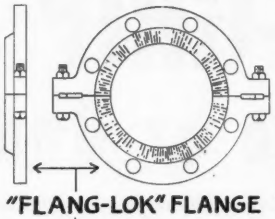
GOODALL RUBBER
E-X-P-A-N-S-I-O-N JOINTS



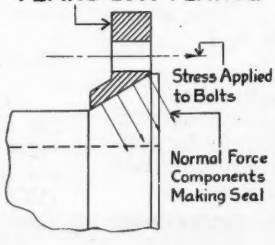
For Handling Fluids and Gases Under Vacuum, Pressure and Temperatures Up to 250° F.

For standard pipe sizes from 3/8" to 96" I.D. Movement is accommodated in corrugation —no stress on pipe lines.

PATENTED "FLANG-LOK" ENDS simplify installation of the expansion joint and provide approximately 35% more face area for seal than other types. Cast iron or cast steel retaining flanges can be supplied. Faces of joint are rubber covered. Bolt holes easily aligned by turning flange ONLY. Magnitude of forces making seal is in direct proportion to stress applied to bolts when tightening.



"FLANG-LOK" FLANGE



"Engineered" to Your Job

Standard or special joints are furnished to meet the particular conditions under which they are to be used. Advise us of material to be handled; vacuum or pressure; temperature; amount of movement required; face-to-face dimensions. Send this information, with I.D. of pipe, and let us quote on the number needed.

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RUBBER COMPANY INCORPORATED

WE ARE PARTICIPANTS IN THE OWNERSHIP AND OPERATION OF NATIONAL SYNTHETIC RUBBER CORPORATION

THE GOODALL-WHITEHEAD COMPANIES

Philadelphia • Trenton • New York • Chicago • Pittsburgh • Boston
Los Angeles • San Francisco • Seattle • Salt Lake City • Houston

Factory—Trenton, N. J. **Established 1870**

Whatever combination of conditions your springs must fight...

CORROSION • RUST • HEAT • COLD • HIGH STRESS • FATIGUE

Whatever type of spring you need...

COMPRESSION • EXTENSION • TORSION • SPIRAL • FLAT • CLIP • RETAINER • GARTER • BANANA

Consider these alloys first...

MONEL* • "K" MONEL* • INCONEL* • "Z" NICKEL* • NICKEL

There is no need to put up any longer with repeated troubles that can be avoided by using INCO Nickel Alloy springs for corrosive conditions and elevated or sub-zero temperatures.

Now, rustless, high-strength springs can be made of five different INCO Nickel Alloys to withstand corrosive attack and temperatures up to 750°F. or even higher.

And they cost so much less than special alloy springs that it is practical to use them for any application where heat, corrosion or fatigue are causing you trouble with ordinary spring parts.

NICKEL · INCO TRADE MARK · ALLOYS

HERE'S A CHANCE TO GET RID OF THE SPRING PROBLEM THAT HAS BEEN BOTHERING YOU

Send for "ANALYZING THE SPRING PROBLEM." When you get this simplified worksheet, jot down the data about your spring problem and what you want in a spring. The information you supply, plus our service records and test data, will enable us to judge which material can be recommended for your particular service. Then, we will cooperate with your spring manufacturer to work out the answer to your problem. That is all you need to do. Write today for "ANALYZING THE SPRING PROBLEM."

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK 5, N.Y.

centrifugal compressor engineering for the past 22 years and before becoming president of Roots-Connersville, he was manager of the Blower and Compressor Dept. of Allis-Chalmers Mfg. Co.

Crocker-Wheeler Electric Manufacturing Co., Division of Joshua Hendy Iron Works at Ampere, N. J., has recently appointed Frank E. Nutt, assistant sales manager. He was replaced at his former post as manager of the company's Washington, D. C. office by A. M. R. Lawrence, Chevy Chase, Maryland.

Philadelphia Gear Works, Inc. of Philadelphia has recently made the following appointments. Leroy L. Handy, 6932 Cass Ave., Detroit 2, Mich., will represent the company in the Detroit area on all products including Limitorque valve controls. Atwood Machinery Co., 931 Santa Fe Ave., Los Angeles 21, Calif., will handle the Southern California territory on everything except Limitorque valve controls.

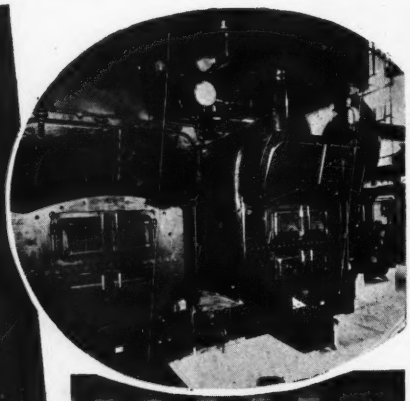
Personnel changes in the Westinghouse organization include: L. E. Osborne, named senior operating vice president of the Westinghouse Electric Corp., responsible to the President for all manufacturing units of the company. Mr. Osborne's new responsibilities include all subsidiary manufacturing companies as well as the district manufacturing and repair department and the headquarters manufacturing division of Westinghouse. His office is transferred to the company's Pittsburgh headquarters. William G. Miller has been appointed manager of the headquarters' manufacturing staff at Pittsburgh, Pa., and will be responsible for the headquarters' manufacturing activities of the equipment manufacturing engineering, production, quality control and wage incentives departments. Ralph H. Sroufe transferred to Portland, Ore., as manager of the Westinghouse Electric Supply Co. in that city. Robert T. Rogers will succeed Mr. Sroufe at Des Moines. Carl E. Nagel, becomes manager of editorial service. John G. Lee is now manager of the Sioux City, Iowa, branch.

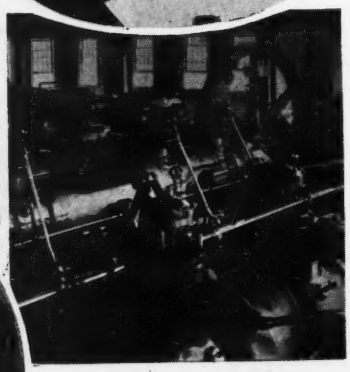
HAERING GLUCOSATES

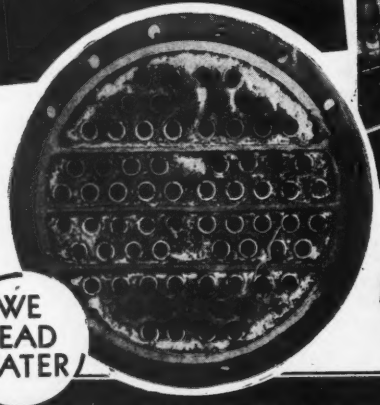
over a period of years have controlled

Corrossion, Scale and Algae

in INDUSTRIAL PLANTS







WE READ WATER

Write on your letterhead for the latest "H-O-H Water Studies"

D. W. HAERING & CO., Inc.

GENERAL OFFICES:

205 West Wacker Drive, Chicago 6, Illinois

Edward Valves, Inc., East Chicago, Ind., has announced that Raymond A. Durand, formerly assistant sales manager, has been advanced to the position of sales manager. Mr. Durand has been a member of the Edwards engineering sales organization for more than nine years.

Precision Thermometer and Instrument Co. of Philadelphia, Pa., has announced the election of Carl H. Waser as president and treasurer. Mr. Waser, formerly secretary and treasurer of the company, came to the organization in 1928. His father, Carl Waser, was one of the original founders of the firm.

Link-Belt Co. has appointed Arthur J. Olson, formerly district sales manager of the company at Chicago, the district sales manager at Kansas City, Mo. He succeeds Max Giffey, who has resigned after 40 years service with the company.

American Chain & Cable Co., Inc., Bridgeport, Conn., has announced the following changes in its organization: Wilmot F. Wheeler becomes president, succeeding the late William T. Morris. Mr. Wheeler has been with the company since 1916, was elected a director in 1919 and treasurer in 1920. He has been executive vice president and treasurer since 1936. Cyrus N. Johns becomes executive vice president, having formerly been vice president in charge of operations of all plants. Stanley Mann becomes treasurer, being advanced from assistant treasurer which position he has held since 1943.

Justrite Mfg. Co. of Chicago has recently appointed Paul V. Miles, formerly Asst. Sales Manager, Railroad and Illuminating Department, Corning Glass Works, as Western Manager. Mr. Miles is located in San Francisco with temporary quarters now in the Monadnock Building.

Rockwell Mfg. Co. of Pittsburgh, Pa., has announced that A. J. Kerr, formerly general sales manager, has been elected vice president of sales for the company. Mr. Kerr will coordinate the marketing activities of the various subsidiaries and divisions. These include Pittsburgh Equitable Meter Division, Nordstrom Valve Co., Rockwell Machine Co., The Delta Mfg. Co., The V & O Press Co., Edward Valves, Inc., The Crescent Machine Co., Rockwell International

TURBINE LUBRICATION

Turbine Oil gives 34 SERVICE HOURS per Gallon over 6 YEAR PERIOD

Extent of conditioning has been to run oil through centrifuge at only 3 intervals during entire time

Lubrication Engineer's Report

"The service record of the 25,000 KW Unit in The Empire District Electric Company's Steam Turbine plant located at Riverton, Kansas, covers a six year period — beginning April, 1939.

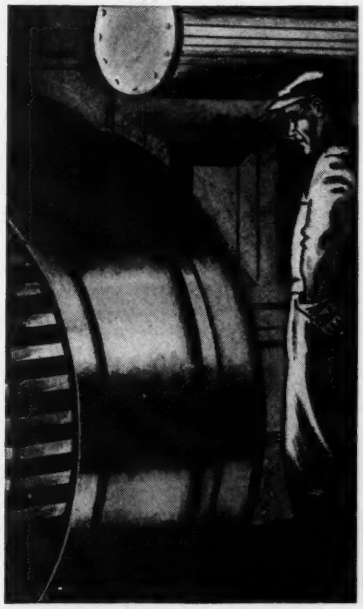
"During this time the *same* oil has been in use and 'make-up' has totaled 1,431 gallons, or an average of 34 service hours per gallon of make-up. Quantity of oil in the oiling system is 1,100 gallons. Neutralization number on oil at start of this run was .05 mg. KOH; maximum value reached was .320 mg. KOH; the average value was .208 mg. KOH; and present value .250 mg. KOH.

"There has been no draw-off of oil to add "sweetening." The make-up added has been to compensate for losses due to vaporization, leakage and such losses as occur during routine machine inspections.

"The extent of the conditioning this oil received has been to run it through a centrifuge at three intervals in the six years to remove any accumulated moisture resulting from condensation in the reservoir.

Moisture Content Negligible

"One of the reasons for the successful performance of the Cities Service turbine oil is the method used to vent the system of vapors. The hot oil return from the bearings to the reservoir, empties into a chamber carrying the screens to remove foreign particles that might damage the oil circulating pumps. A considerable vapor is liberated at this point (oil temperature, 150-160 deg. F.), and instead of being permitted to condense is drawn off through a vent line, under a slight vacuum. While there is a tangible loss of oil in the

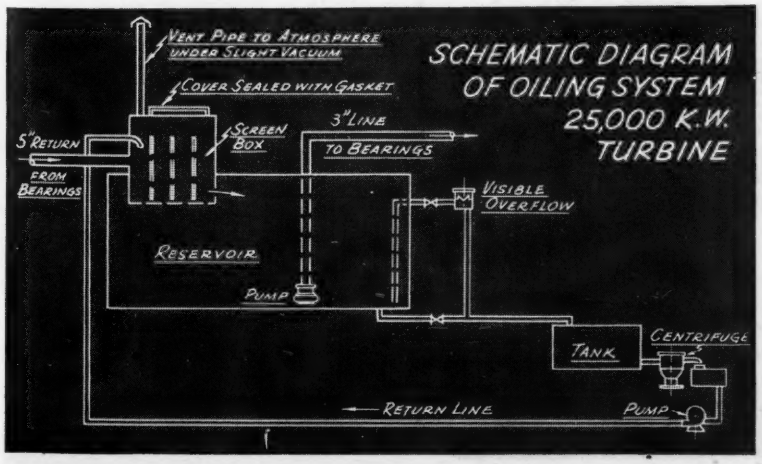


vapor, the moisture content is held practically negligible and is, therefore, of material help in maintaining the oil in good condition.

"The above is typical of the experience with Cities Service turbine oil in each of Empire's five turbo-generator units."

Expert Counsel Available

Cities Service Lubrication Engineers know ways and means for reducing costs and improving the performance of lubricants. For help or information call the branch office nearest you, or write Cities Service Oil Co., 60 Wall Tower, New York 5, N. Y.



SCHEMATIC DIAGRAM OF OILING SYSTEM 25,000 K.W. TURBINE

CITIES SERVICE OILS
ONCE-ALWAYS

FOR EVERY LUBRICATION PROBLEM
CALL Cities Service FIRST!

Corp., Monessen Foundry and Machine Co., and Arcade Mfg. Division.

Walter F. Spoerl has been appointed general sales manager of the mechanical goods division of United States Rubber Co., it was announced today. Mr. Spoerl succeeds Herman A. Everlien, who died suddenly February 21 after 43 years with the company. Mr. Spoerl began his rubber career 38 years ago as a clerk in the company's sales offices in Chicago. He rose through various sales and administrative positions to become merchandise manager of the mechanical goods division in 1944, the position he held at the time of his new appointment.

The Allied Control Valve Co., Inc., of South Norwalk, Conn., has acquired the solenoid division of the Henry Valve Co., Chicago. Hal McPherson, formerly with the Henry Valve Co., as chief engineer, is now with Allied as vice president in charge of engineering.

Thomas B. Allardice, formerly of American Gas & Electric Service Corp. and recently returned from Italy, has joined Combustion Engineering Co., Inc. While in Italy he served with the Allied Commission as consultant on coal and power. Mr. Allardice will act as consultant in the application of C-E steam-generating units to the utility industry.

The Terry Steam Turbine Co. has announced the appointment of Glenn C. Barnaby, Rialto Bldg., San Francisco, as its representative in the San Francisco area.

The Wellman Engineering Co., Cleveland, has announced the election of W. C. Swalley to the position of vice president in charge of sales.

The Helicoid Gage Division, American Chain & Cable Co., Inc., announces the appointment of C. Emery Nelson as its representative in Minneapolis, Minnesota.

J. B. Dannenbaum, 3940 Main St., Houston, Texas, has been appointed agent by S. P. Kinney Engineers, Inc., to handle the Brassert Automatic Self-Cleaning Water Strainer in the Southern Texas District.

GENERAL
REG. U.S. PAT. OFF.

RODA
High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON
High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA
High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER
A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE
Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL
High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER
Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

LYNCO
Medium volatile, high fusion coking coal for by-product and steam use from Wyoming Co., W. Va., on Vgn. Ry.

Old Kentucky
Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

CHARMCO
Unexcelled Steaming Coal from the Fire Creek Seam in Greenbrier County, W. Va., originating on the N. F. & G. R. R.

ANTHRACITE — Hazle Brook Premium
. . . Raven Run

General Coal Company
123 SOUTH BROAD STREET, PHILADELPHIA 9, PA.

BRANCHES:
BLUEFIELD, W. VA. BOSTON BUFFALO CHARLOTTE, N. C.
CINCINNATI DETROIT NEW YORK NORFOLK PITTSBURGH

New ENGINEERING BOOKS

Primary and Storage Batteries, by E. S. Lincoln; First Edition; 168 pages; 5½ by 8½ inches; illustrated; cloth; published by Duell, Sloan and Pearce, 270 Madison Avenue, New York, N. Y.; 1945. Price $3.00.

This is the sixth volume of a series of books entitled, Essential Modern Electrical Series, published by Duell, Sloan and Pearce. This particular volume provides a wealth of practical information about primary and secondary, or storage batteries. The primary battery section covers the application and selection of dry cell, wet cell, caustic soda, and copper-oxide batteries. The section on storage batteries covers the two major divisions, the lead acid type and the nickel-iron alkaline type.

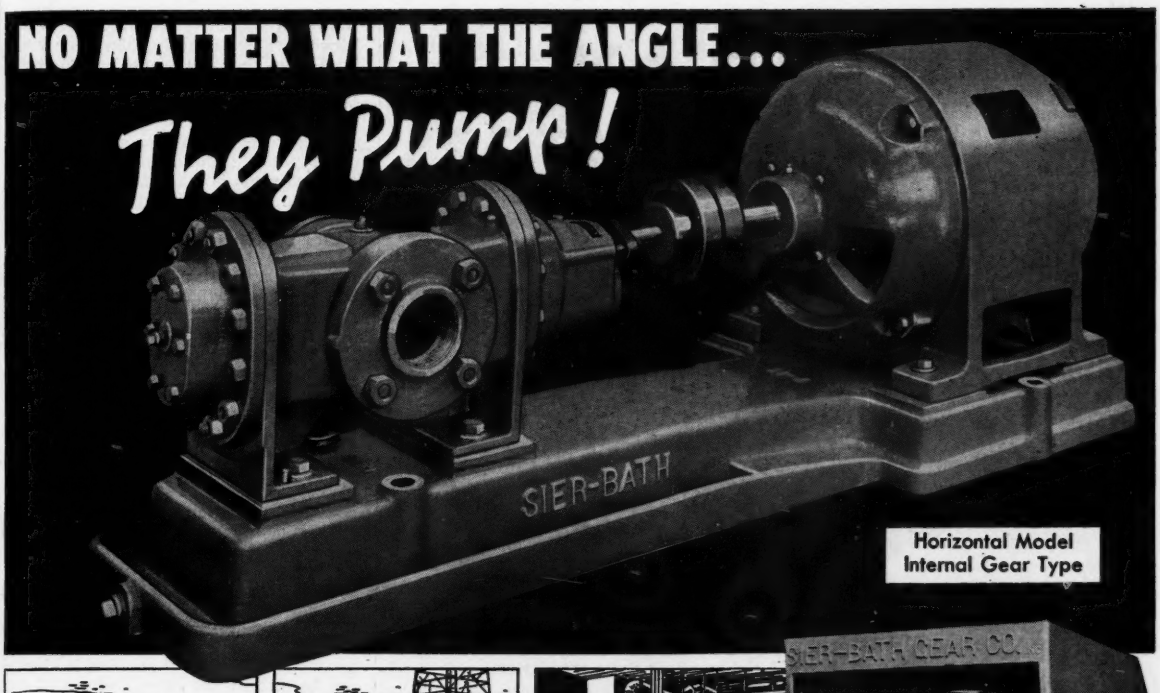
Instructions for the selection, use, and maintenance of battery accessories are also included in the text. The book describes modern methods of charging and discharging storage batteries, together with details of charging generators, rectifiers, and control equipment. It provides as well many tables and definitions which will be found useful to every reader who seeks information about the various aspects of generating or storing electricity by chemical means.

Principles of System Relaying, a report of the Electrical Equipment Committee, of the Edison Electric Institute, 44 pages; size 8½ by 11½ inches; published by the Edison Electric Institute, 420 Lexington Avenue, New York, N. Y. Price 60 cents to members of the Institute and their employees, $1.50 to non-members in the U.S.A.

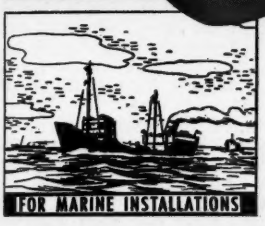
This report contains a series of papers and accompanying discussions which constitute a symposium on the principles of system relaying, presented in two parts at successive meetings of the Electrical Equipment Committee. One part deals with Metropolitan Type Systems and the other with Transmission Type Systems. The paper also covers several different systems and illustrate the application of relaying principles to a variety of system conditions.

NO MATTER WHAT THE ANGLE...

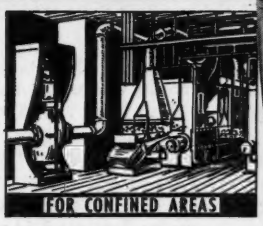
They Pump!



Horizontal Model
Internal Gear Type


FOR MARINE INSTALLATIONS

FOR OUTDOOR LOCATIONS

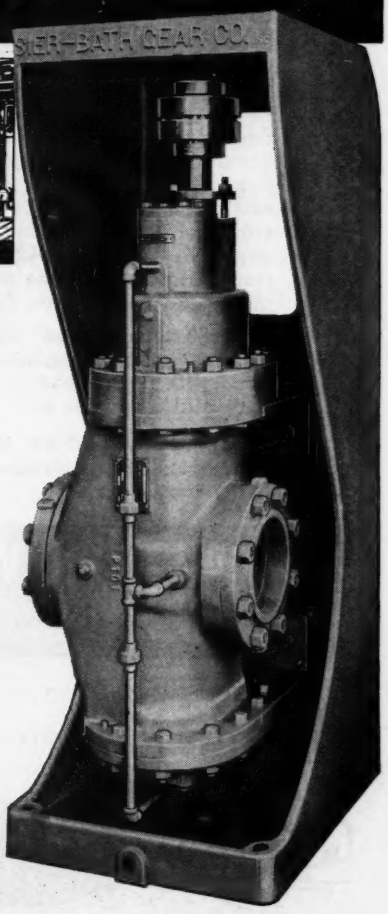

FOR CONFINED AREAS

SIER-BATH SCREW PUMPS

(INTERNAL GEAR TYPES)

WHEN the fluid is thick and the location inconvenient, you need Sier-Bath Screw Pumps. They are practically unaffected by angle of inclination, and their smooth, vibrationless operation permits installation where deep foundations are impossible. Having only two moving parts, they require little maintenance. Highly efficient over a broad flow range, Sier-Bath Screw Pumps are less affected by varying head pressures. *They were the first screw pumps to incorporate needle bearings as standard design.* Removable liners may be specified. Write for bulletin.

SIER-BATH GEAR CO. INC., 9256 Hudson Blvd., North Bergen, N. J.

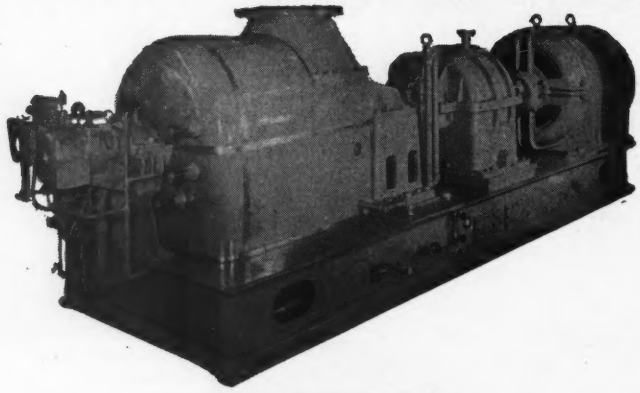


Vertical Model
This unit handles Bunker C Fuel Oil. Rated at 350 G.P.M. 50 p.s.i., 10" vacuum, 20 h.p., 1150 r.p.m. motor drive. Built for Y tankers A.S.F.

Sier-Bath Gear Co. Inc.
PUMP DIVISION

PUMPS:
Acetates—
Asphalt—Brine
Bunker C Fuel Oil
Cellulosics—
Greases—
Molasses—
Syrups—Soaps

MURRAY
TURBINE GENERATORS



500 KW—PACKAGE TYPE

The unit shown above was designed to deliver 500 KW 50 cycle alternating current on steam at 285# gauge, 700 degrees F., and exhausting condensing to 27 inches vacuum. Thirty identical units were furnished.

Equipment included trip and throttle valve, oil relay governor controlling single throttling inlet valve with hand valve control for partial load operation, all service connections above floor line except generator leads, drain piping brought to one point, and structural steel baseplate. The baseplate is sufficiently rigid so that the unit can be handled in one piece, and installed on the simplest of foundations.

While "Package Type" units are furnished for export for installation in remote areas not previously supplied with power, similar designs can be made for industrial plants for main or standby power supply.

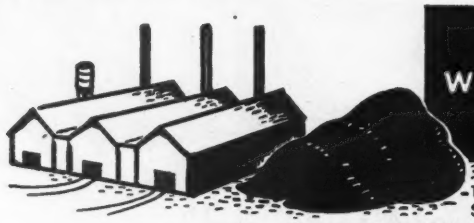
MURRAY *also produces:*

Mechanical drive turbines, horizontal and vertical
Reduction Gears **Steam Boilers**

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY



HAVE YOU WASTE MATERIALS TO BURN?

—The John Phillips BADENHAUSEN System for burning sawdust and other waste materials in suspension, without grates or the conventional dutch ovens, has proved a real economy through savings in fuel, installation costs and great reduction in operation and repairs.

If you have not given careful and serious consideration to the use of your waste materials for fuel, a meeting with our engineers will give you a clean-cut picture of possible great economies.

"Burning Waste Wood in Suspension" is the title of an article by John Phillips Badenhausen which appeared in a recent issue of a technical journal. We will gladly send you a reprint on request.

JOHN PHILLIPS BADENHAUSEN, INC., 18th Floor, Packard Building, Philadelphia 2, Penna.

Boilers — Firing Systems — Superheaters — Sawdust Burners — Special Installations Designed to Increase Existing Facilities

Industrial Electric Wiring, by E. S. Lincoln; First Edition; 336 pages, 5½ by 8¼ inches; illustrated; cloth; published by Duell, Sloan and Pearce, 270 Madison Avenue, New York, N. Y.; 1945. Price $3.00.

This book describes and analyzes every phase of construction, operation and maintenance of all systems for both a-c and d-c wiring. Detailed instructions for designing and installing wiring systems recognized by the National Electrical Code are also provided, along with a specially prepared listing of all wiring devices and fittings required for each of the numerous wiring methods covered in the text.

A special index arranged for the convenient use by the designing and operating engineer, provides a guide to the proper installation of protective grounding for all electrical systems and apparatus.

Everyday Problems in Economics, by May Wood-Simons, Copyright 1945, 6 by 8½ inches, 520 pages, illustrated, cloth cover, published by the American Technical Society, Drexel at 58th Street, Chicago, Ill. Price $3.50.

Economics is sometimes called "the dismal science." As taught by some people it is indeed that. But it should not be dismal, for every individual has problems in economics; how much income he gets, where it comes from, and what it is spent for. He thinks of them as "who gets what?"

An attempt to describe these problems in terms the layman can understand, giving wherever possible some of the past and present solutions, can be of great value. It is so in this case, because the author has been successful in translating some of the "highbrow" thinking and abstruse verbalizing of economists into plain English. When this is done, the cynical suspicion is aroused that maybe some economists have tried to make simple problems seem complex.

This book has a number of features that will clarify many of your own common economic problems. Among these features are a concise statement at the beginning of each chapter telling the author's objective in writing that particular chapter. In addition, a preview of the subject matter is also presented so that the reader may have an idea of the ground to be covered. As the colored preacher told a young man aspiring to become a member of the clergy, "In my sermons, first I tells 'em what I is goin' to tell 'em, then I tells 'em, then I tells 'em what I told 'em." Essentially, this is what the author does in this book.

The chapters are broken down logically into units so that the material is presented one step at a time, and key points at the end of each unit spotlight the important points and serve to fix them in the reader's mind. At the end of each chapter are text questions to review the material of the chapter and to stimulate thought about the points discussed therein.

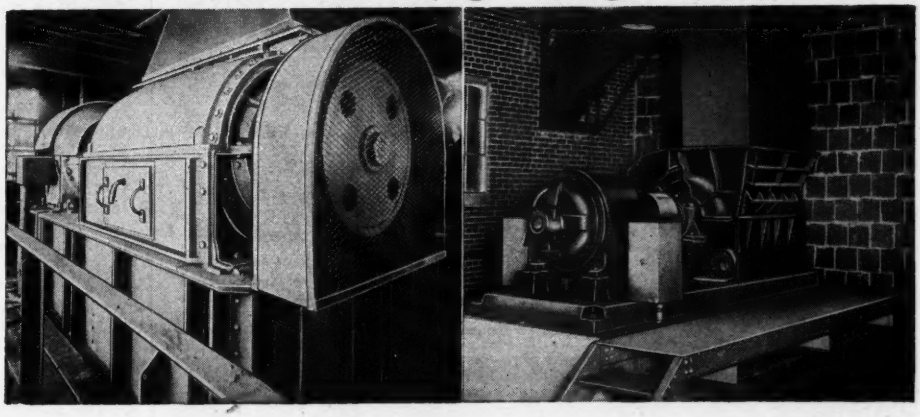
At the end of the book is a dictionary of economic terms giving the specialized economic application of many words and terms not usually found in an abridged dictionary.

The following lists of chapter titles presents a good outline of the material covered:

FOR A COAL CRUSHING OPERATION

THAT'S COMPACT and COMPLETE

. . . install AMERICAN *Rolling Ring* CRUSHERS



Americans give high tonnage, uniform sizing and refuse disposal without auxiliary operations . . . .

The manganese steel shredder rings are an exclusive patented feature of American. Each ring, with its 20 cutting teeth, revolves at the proper centrifugal force *splitting coal instead of crushing it.* The shredder rings, revolving free on their own shafts, deflect from tramp iron.

These two power plant installations of American Crushers are typical of many throughout the world. Their compactness of design and construction makes for a complete, efficient installation in limited headroom and with savings of valuable space.

No auxiliary operations or equipment is necessary to the high performance of Americans. No extra operational or maintenance labor is required for the operation of Americans.

An American Rolling Ring Crusher handles its own refuse. There is no refuse disposal problem in an American installation. American Rolling Ring Crushers provide a *complete* high capacity, *extremely* low cost crushing operation uniformly reducing ROM coal to stoker or pulverizer sizes—handling waste and rejecting tramp iron—for complete safety to mechanical firing devices.

There's an American to fit your operation. Capacities from 25 to 500 TPH.

WRITE FOR "CRUSHING COAL AT LESS THAN 1c PER TON"

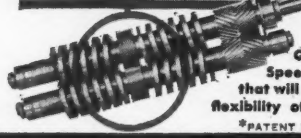
American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1429 Macklind Ave.
St. Louis 10, Mo.

There is NO Substitute for a . . .

QUIMBY SCREW PUMP



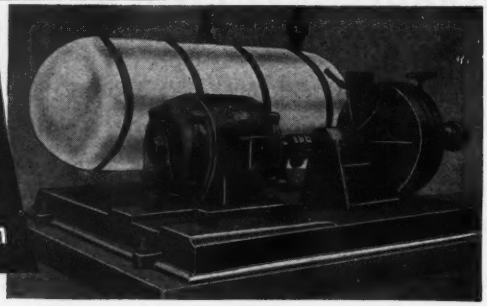
New! QUIMBY FLOATING LINK* An exclusive QUIMBY feature: Permits Higher Pressures—Higher Speeds—Lower Viscosities. A revolutionary new feature that will vastly increase the efficiency, temperature range, and flexibility of the screw pump. Write for complete information.

*PATENT PENDING

H. K. PORTER COMPANY, Inc.
PITTSBURGH 22, PENNSYLVANIA
Quimby Pump Division
NEWARK 5, N. J.
District Offices in Principal Cities

QUIMBY PUMPS
The KNOW HOW of Pumping since 1894

Increase YOUR PRODUCTION with the STOUT NO-VENT Boiler Return System



—for Cookers, Heaters, Driers, etc.

It operates continuously returning condensate, ALL OF IT, fast as formed and at the same pressure and temperature at which it leaves the steam heated units. Air and non-condensibles are then automatically removed and the condensate, in the form of distilled water, returned direct to boiler. There are no traps or orifices in the system.

High temperature direct return saves fuel. Often 25% or more. (This would offset the 20% cut expected in soft coal deliveries to industry as announced July 14th by Secretary Ickes.)

Improved circulation the Stout NO-VENT way uniformly increases the temperature in steam heated units and increases production. Reducing boiler load and returning distilled water prolongs boiler life.

If you operate steam heated cookers, heaters, driers, ironers, clothing presses, drying ovens, oil tanks, water tanks, pickling tanks or have other uses for so-called "process steam" investigate the Stout NO-VENT Boiler Return System. It can boost your production.

HEAT RECLAIMER CORP. • 6 N. Michigan Ave. • Chicago 2, Ill.
Heat Reclaimers • Steam Condensers • Spiro Water Heaters • Gas Fired Boilers

Write for bulletin showing hookup of Stout NO-VENT System and giving operating details. Made in capacities 100 to 800 bhp, pressures to 200 lb. Distributors will be interested in selling franchise.

Stout NO-VENT BOILER RETURN SYSTEM

Historic Background of Our Economic Structure; What Is Economics; The Consumer—His Desires and His Ability to Pay; Production of Commodities and Service; Exchange of Commodities and Services; Price Determination; Index Numbers, Price Levels, Crises; National Income; Distribution—How the National Income is Divided; An Interpretation and Appraisal of Economic Theory; The Farm Problem; Labor Problems; Trade Associations; Corporations and Monopolies; Public Finance; Democratic Economic Planning.

Vapor Adsorption, by Edward Ledoux, Copyright, 1945, 6 by 9 in., 400 pages, illustrated, cloth cover, published by the Chemical Publishing Company, 26 Court Street, Brooklyn 2, N. Y. Price $8.50.

This book aims at presenting a clear understanding of adsorption and its application to engineering and industrial projects. The book goes a step further than most in that it discusses industrial dynamic adsorption, a subject which heretofore the engineer has had to explore for himself.

Adsorption is defined by the author as a particular type of sorption in which the vapor is held at the surface of the solid, without chemical reaction and without an intimate mixture between the molecules of the solid and those of the vapor.

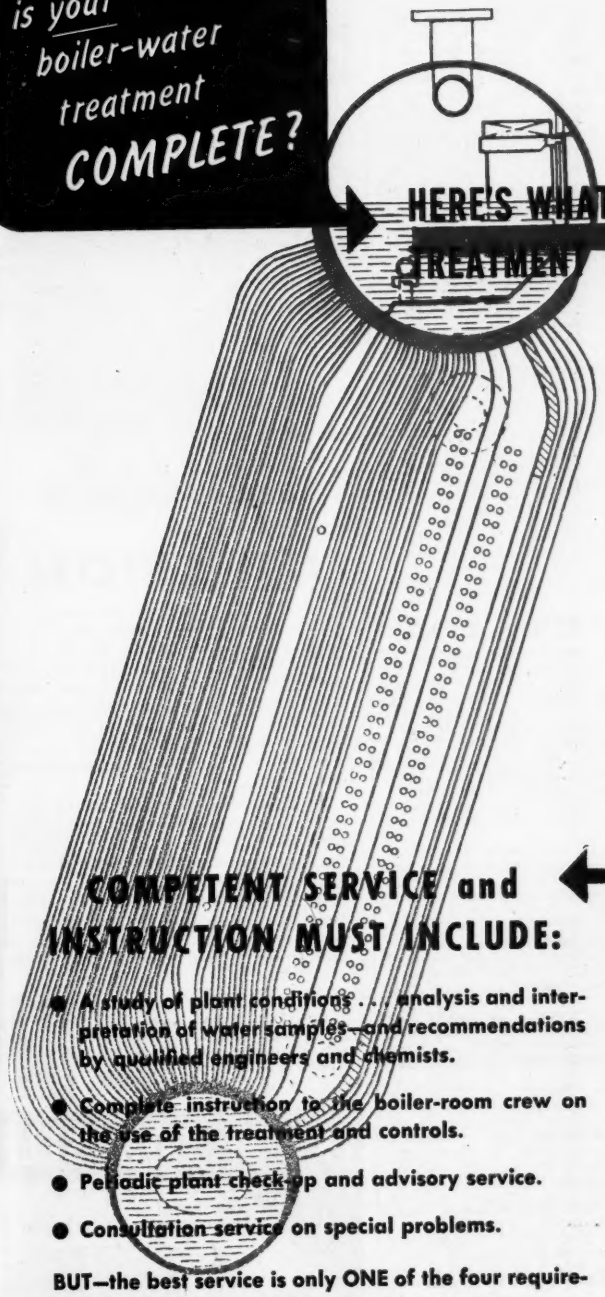
The process, as well as its terms and applications, has become familiar to air conditioning and refrigerating engineers during the past few years. The action of silica gel is probably the most familiar of these; even the nontechnical public has acquired some familiarity with it during the war.

But even in the minds of many engineers there is still some confusion as to the really technical and scientific distinction between *ad*sorption and *ab*sorption. This book will help to clear up any such confusion.

To understand the phenomenon as discussed in this book, the engineer will need to know some chemistry. However, the physical and physiochemical background of adsorption, the essentials of vapor and heat transfer and saturation of air are discussed to help the engineer understand the subject and apply it to industry.

The following aspects of it are considered: Part I—Static Adsorption. Chapters: The adsorption equilibrium; Effects of an external force applied to the liquid or solid phases; Adsorption potential and properties of the adsorbate; Heat of adsorption; Capillary adsorption. Part II—Saturation of Air. Chapters: Definition; Heat transfer and heating efficiencys; Vapor transfer and saturation efficiency; Adiabatic saturation. Part III—Dynamic Adsorption. Chapters: Isothermal desorption; Isothermal adsorption; Adiabatic adsorption; Adiabatic desorption. Part IV—Industrial Applications. Chapters: Industrial applications of static absorption; Dehumidification by condensation; Dehydration by adsorption; Dehumidification by adsorption; Air conditioning; Conditioning of underground spaces; Drying of hygroscopic material; Forced-draft, Low-temperature drying; Dehydration of compressed gases; Drying of optical instruments; Vapor recovery.

is your boiler-water treatment **COMPLETE?**



HERE'S WHAT COMPLETE TREATMENT *MUST* INCLUDE

1. Sound Chemical Treatment
(discussed in the February issue)

2. A Good Organic Coagulant
(discussed in the March issue)

3. Simple But Scientific Control
(discussed in the April issue)

4. Competent Service & Instruction

COMPETENT SERVICE and INSTRUCTION MUST INCLUDE:

- A study of plant conditions . . . analysis and interpretation of water samples—and recommendations by qualified engineers and chemists.
- Complete instruction to the boiler-room crew on the use of the treatment and controls.
- Periodic plant check-up and advisory service.
- Consultation service on special problems.

BUT—the best service is only ONE of the four requirements for COMPLETE boiler-water treatment.

If you want to know the many ways in which real service can help you, talk it over with the DREW Man—there's no obligation!

E. F. DREW & CO., INC.
15 East 26th Street, New York 10, N. Y.
COMPLETE AMEROID SERVICE is available in key cities of the United States, Canada, Mexico, Brazil and Porto Rico

AMEROID

THE COMPLETE BOILER-WATER TREATMENT

MAIL THIS COUPON TODAY!

E. F. Drew & Co., Inc.
15 E. 26th St., New York 10, N. Y.
I am interested in further information about COMPLETE Boiler-Water Treatment.

NAME_____

FIRM_____

ADDRESS_____

103

Economize WITH POWERS

TEMPERATURE REGULATORS

Use a Powers No. 11 Temperature Indicating Regulator when you want the advantages of an easy-to-read dial thermometer combined with a dependable self-operating regulator. The dial thermometer gives a visual check on the performance of the regulator and makes it easy to adjust for the required operating temperature. Various dials and ranges are available.

Is Easy To Install—because both the thermometer and the regulator operate from the same thermal system—only one tapped opening is required.

Write for Circular 2511

THE POWERS REGULATOR CO.

2746 Greenview Avenue, Chicago 14, Illinois
231 E. 46th St., New York 17, N. Y.—Offices In 47 Cities . . . See your phone directory.

70

OVER 50 YEARS
OF AUTOMATIC TEMPERATURE AND HUMIDITY CONTROL

HELPFUL BULLETINS

(Continued from page 32)

53 **Handbook On Hard Facing**—104 pages comprise this booklet titled "494 Ways To Save Money." The fore part of the book is devoted to descriptions and listings of the hard-facing material available and to telling of these materials' properties. Chapter headings indicate the scope of the remainder of the book. These are: Agriculture; Automotive; Brick; Cement; Coke and Gas; Excavating; Iron and Steel; Lumber and Paper; Machinery; Mining; Oil and Gas; Power; Other Industries. The back portion of the book covers the hard-facing procedure. It is extremely well indexed. Haynes Stellite Co.

54 **Industrial Dust Recovery System**—The principle and practice of industrial dust recovery are extensively covered in this carefully prepared 32-page booklet. Subject matter of the various sections is as follows: Dust—what it is; the inside story of the double-eddy current; technical aspects and basis for guaranteeing dust collecting efficiency; how changes in particle size affect overall efficiency; installations for various types of industries; for flue dust collection; custom built; story of the laboratory. The booklet is well illustrated. Buell Engineering Co.

55 **Splicing Compounds and Tape** — A new catalog on its line of rubber tapes and splicing compounds has just been published by this company. Featured is the Two-In-One tape which weatherseals wire or cable splices in one operation in less than half the time needed for the combined use of tape and splicing compound. A single layer is said to provide adequate insulation for lines carrying up to 220 volts; a double layer on lines up to 650 volts. The B. F. Goodrich Company.

REFRIGERATION, A. COND.

56 **Air Distribution Panel**—Described as producing uniform, no-draft air distribution is the Multi-Vent Panel covered in this latest publication. A large photograph shows features of the panels and helps in the explanation of its construction and operation. The Pyle-National Co.

57 **Liquid Cooler Information**—Niagara Blower Company has issued a catalog sheet on its liquid cooler. It is Bulletin 100. The unit is pictured and a complete explanation of its method of operation is given.

58 **Water Coolers**—The new catalog of this firm describes the post-war line of AC and DC water coolers for business, industrial and institutional use. All models are illustrated and complete specifications of each are given. Sunroc Refrigeration Co.

59 **Evaporative Coolers** — Eight pages of compact data and tables are included in this new bulletin of the company's evaporative coolers. Practically one full page is devoted to specifications and optional extras while another section shows typical piping arrangements. Dimensioned line drawings accompany tables of sizes and capacities. Worthington Pump & Machinery Corp.

60 **Refrigeration Purger** — "Take the Brakes Off Your Refrigeration System" is the title of an 8-page data book just issued. It describes this company's non-condensible gas purger. It shows how non-condensible gases in the high side of a refrigeration system increase the pressure against which the compressor must work. It shows how to cut power costs and presents pictures of what the purger is doing in many installations. Extremely useful colored diagrams show how the unit operates. Physical data and list prices are also given. Armstrong Machine Works.

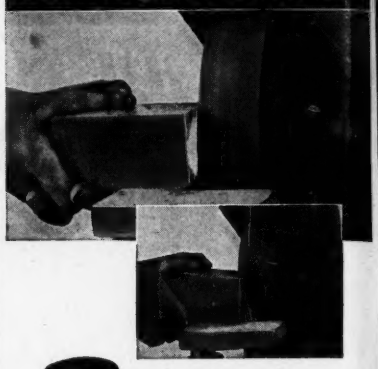
MISCELLANEOUS

61 **Rust, Pitting, Corrosion and Scale Deposit** — This 4-page bulletin tells about "Corosanti" boiler metal treatment. It is pointed out that this is not a boiler compound but a metal treatment. The efficiency, non-insulating and economy features of the treatment are described and testimonial letters are presented. The bulletin tells about the time required for the treatment, the dose and the different grades of treatment. Morse Boulger Destructor Company.

62 **Directory of Parts and Accessory Equipment**—This booklet of 48 pages was prepared as a guide to this company's exhibit at the exposition of the chemical industries but it is a handy permanent listing of the suppliers of nickel-alloy parts and accessory equipment. Many of the

BRICKSEAL

REFRACTORY COATING



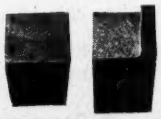
Resists

ABRASION

PROTECTION against abrasion is an outstanding advantage of Brickseal. Here are two refractory bricks, one coated with Brickseal, the other uncoated. They were heated to more than 2000°, taken directly from the furnace, cooled and shoved against an emery wheel. Hot and cold, the Brickseal-treated brick resisted the abrasion – see below.

Brickseal consists of high fusion clays and metal oxides combined in oil. Furnace heat burns away the oils and vitrifies the clays and metals which penetrate deeply into the pores, cracks and joints. Brickseal prevents cracking, spalling and slagging regardless of sudden temperature changes. Brickseal is also a mortar for laying up refractory walls.

Compare the Brickseal-treated brick at the left to the untreated at the right.



TRY IT YOURSELF

on your emery wheel

Two bricks bonded together and partially coated with Brickseal will be mailed to you on request.

BRICKSEAL
REFRACTORY COATING

5800 So. Hoover St., Los Angeles, Calif.
1029 Clinton St., Hoboken, New Jersey

The FARRIS Separator Bell *is no* "dumb-belle"!

When escaping steam strikes a Safety Valve spring, the molecular change in the steel affects your blow-down setting. Valves then "pop" at lower-than-set-point pressure – diminishing the efficiency factor . . . and their delayed shut-off—*after* pressure is normalized—causes costly working-pressure losses.

The FARRIS Separator Bell (patent pending) was designed by our engineers to prevent such action. By insulating – and thereby cooling – the steel spring, the Separator Bell maintains the spring's molecular structure. You get *precise* set-point "pops" to *insure safe blow-down operations* . . . and *accurate* shut-offs to *eliminate working pressure losses.* Indeed – the FARRIS Separator Bell *is* no dumb-belle!

Furthermore, the Separator Bell eliminates the chances of scalding workers when discharged steam escapes into the boiler room. This is accomplished by reversing the direction of the steam several times, which throws off free liquid. And by cradling the spring, the Separator Bell also absorbs any possible spring distortions which cause troublesome friction and undue wear in ordinary safety valves.

Our *new* catalog contains full information explaining how FARRIS Safety and Relief Valves give you safer, more economical, and trouble-free performance. *Write for your copy today.*

FARRIS ENGINEERING COMPANY
380 Commercial Avenue, Palisades Park, N. J.

Venturi Port Safety Valve No. 2150. Built in heavy symmetrical construction to control distortion. Spring covers furnished. Cast steel, alloy trim. Sizes: 1½" to 6" (inlet size) for pressures to 600 lbs.—750° F.

FARRIS KEEPS PACE WITH ADVANCING POWER AND PROCESS ENGINEERING

FE-532

Farris
SAFETY and RELIEF VALVES

Descaling Mercury Arc Rectifier Cooling Systems

WHEN scale builds up excessively in the cooling system of your mercury arc rectifier water flow is reduced, cooling retarded and the general operating efficiency of the equipment seriously impaired.

To avoid such trouble, your best bet is periodically to remove the deposits by circulating through coils a recommended solution of inhibited acid scale dissolver Oakite Compound No. 32 as directed. Or, if pumping facilities are not available, fill the coils with solution and allow to soak for the prescribed period. Cooling efficiency is quickly restored to normal. This procedure is simple, effective, surprisingly low in cost and much safer than method using raw commercial acids.

FREE DATA ON REQUEST

Further details on this and 70 other essential maintenance cleaning jobs are contained in 20-page Oakite Digest. Write for your FREE copy TODAY . . . ask for on-the-spot demonstration without obligation.

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MATERIALS • METHODS • SERVICE

items listed in the book are carried in stock by the firms mentioned, but all of them, it is pointed out, can be readily produced to order. The book is well indexed for ready reference. The International Nickel Co., Inc.

63 **Soft Hammers Catalog** — A six-page catalog that includes prices and specifications of this company's line of soft hammers for all types of work has just been released. There are 14 different models and 56 different numbers shown; these range in size frcm ¾ in. dia. head to 2½ in. and in weight from 3 oz. to 10½ lb. Gregory Tool and Mfg. Co.

64 **Silicone Rubber in Industry**—Here is a series of pamphlets titled "Silastic Facts." Of this series the first two bulletins are of general interest to engineers, designers and maintenance men in almost all kinds of industry. The first bulletin is a general introduction to the new and improved rubber which is described as useful over a temperature range of minus 70 F to plus 500 F. The second bulletin is designed for consumers of the product. It contains information about the established uses for the rubber and presents tables giving the physical, electrical and chemical properties of the product. Dow Corning Corp.

65 **Vibration Dampener Bushing Wheels** —This is a small folder which tells about the development in grinding wheels which give a velvety smooth action to hand grinders thus eliminating, or greatly reducing, operator fatigue, increasing output, improving quality and cutting maintenance costs. The Manhattan Rubber Mfg. Div.

66 **Materials Handling, Drills, Feeders, etc.**—This latest issue of "Syntronics" catalogs many of the company's products. Included are pictures and descriptions of the electric vibrator, vibratory feeders, electric hammers and drills, dry feeder machines, paving breakers, hopper level switches, etc. Prices are listed for many of the items. The Syntron Co.

67 **Sanitation and Clarification** — The complete line of this company's sanitation and liquid clarification equipment is presented in a 44-page booklet just issued. Pictures, drawings and diagrams are used extensively throughout the publication. Among the products dealt with in the booklet are: conveyor sludge collectors, sludge removers, grit collectors and washers, thickeners, skimmers, gravity waste water-oil separators and water screens. Chain Belt Company.

68 **Storage and Bulk Handling**—This 32-page data book goes into the reasons why modern storage and bulk handling facilities are necessary in modern industry. Photos show installations in every conceivable type of industry from a chocolate company to an asbestos products company . . . from an oil storage depot to a central station. One of the most useful sections of the book presents tables showing capacities of circular bins holding anthracite or bituminous coals, or grain or cement. Two full pages of drawings show how storage equipment for a cement company was planned. The Nicholson Co.

69 **Speed Reducer Data**—"Clevelands in the Modern Production Flow" is the title of a 4-page pictorial bulletin recently issued. It describes the application of worm gear speed reducers to various types of mixing and grinding equipment. Specifically, the bulletin covers crushing, screening, agitating and polishing. The Cleveland Worm Gear Co.

70 **Metal Fabrication Services** — Here is an interesting 16-page booklet which describes this concern's metal fabrication services. Illustrations show the organization's equipment for cutting, forming, arc welding, oxy-acetylene welding and spot welding as well as a variety of items produced to customer specifications. Hungerford Corp.

71 **Production Lubricant**—A modern lubricant, "I.P." Leadolene which was developed to meet the requirements of modern production methods is described in a new bulletin. The booklet points out how the high film strength of the lubricant is one of its outstanding qualities. The bulletin is well illustrated and departmentalized. The Brooks Oil Co.

72 **Chemistry in Television** — A booklet titled "Phosphors and Their Behavior in Television" has just been announced. The text was written by Irving Krushel, chemical engineer, who describes in detail the chemical processes involved. The booklet contains pictures and graphs which make the text easy to understand. North American Philips Corporation.

The IMO PUMP provides a maximum of capacity in a minimum of space due to the fact that it can be operated at high speeds connected directly to motor, turbine or other machinery.

Where space is a problem install IMO —the reliable rotary, positive displacement pump having only three moving parts and no gears, pistons, sliding vanes or valves.

For further information send for catalog I-129-G.

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TRENTON 2, NEW JERSEY

Learn the secret
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COMBUSTION ENGINEERING

There are plenty of good pay jobs in the power field today. Increase your earnings now—be a Hays-Trained Combustion Engineer. Just a little of your spare time required for the simple, easy-reading Hays Home Study Course. Hundreds of others have made better jobs for themselves through Hays training. So can YOU.

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MOST VERSATILE LIQUID FILTER EVER DEVELOPED

SUPERIOR to any other filter in flexibility and versatility. Puts you ahead of changes that tomorrow may bring. Provides unusual efficiency and economy. Already field-tested over a broad range of applications.

WIDE VARIETY OF FILTERING MEDIA

Design permits use of media to suit practically every requirement. Any medium—metallic, plastic, or fabric—that comes in sheet form and can be crimped may be used. Tested media include types resistant to both hot and corrosive liquids; also types to remove dirt particles down to 2 microns (.000078″) or less in size.

Model ELS Filters handle a total of 105,000 gallons per minute in one large industrial plant.

NEW *SLIP-ON* INSERT FOR QUICK CHANGE OF MEDIUM

An entirely new idea in the application of filtering medium, the STAYNEW SLIP-ON INSERT, permits quick change or replacement of medium.

METHOD OF REMOVING SLIP-ON INSERT

LOW FIRST COST, LOW MAINTENANCE COST

Volume production of an economical design means low first cost. Ease of cleaning or replacement of medium mean low maintenance cost.

LARGE FILTERING AREA IN SMALL SPACE

The well-known Staynew Radial Finned Insert Construction provides the largest possible filtering area for available space.

★ **PARTIAL LIST OF USES** ★

WATER • LAQUERS • VARNISHES • FUEL OILS
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New Uses Developing Constantly.

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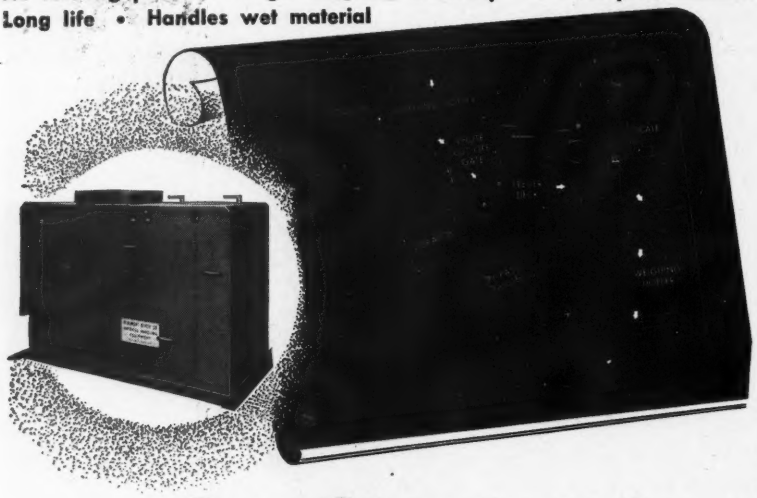
REPRESENTATIVES IN PRINCIPAL CITIES

31 CENTRE PARK, ROCHESTER 3, NEW YORK

No rotating parts • High weighing accuracy • Dust proof cabinet
Long life • Handles wet material



Positive Delivery of material . . .

BEAUMONT "VIBRO" AUTOMATIC
WEIGHING SCALE FEEDER

Complete discharge into the scale hopper is assured because there are no belts to scatter material. The short drop from feeder deck to scale hopper leaves little material in suspension when predetermined amount is weighed in the accurate, automatic "Vibro" Scale. Units are made with adjustable capacities for feeding materials at from 1 to 60 tons per hour. Write for descriptive bulletin.

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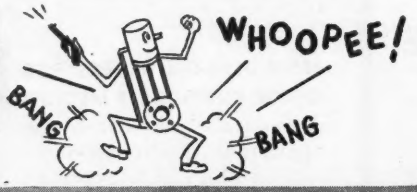
Bothered by SLAM-BANGING Pumps?



They'll run slower and quieter with **COMBINATION**
NON-TILT, NON-SLIP VALVES

Two reciprocating feed pumps at a water plant in New Jersey each handled 40,000 lb of condensate and make-up water per hr. Their valves not only needed frequent repairs, but the pumps raced and hammered whenever the water temperature went up to 218 deg. F.

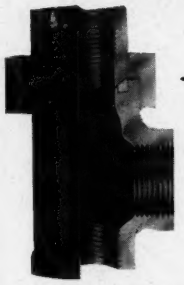
After installing COMBINATION Pump Valves this plant engineer reported "a slowing and steadying with elimination of former racing and hammering."

What COMBINATION Pump Valves are doing for hundreds of other plants, they can do for you. They lift straight, close quickly, prevent slippage, make steam do more work. Seat, stud and springs are made of long-wearing Phosphor Bronze. They match the fine performance of COMBINATION Silent Check Valves. Write for descriptive folder.

For Boiler Feed Vacuum, Condenser General Service

COMBINATION PUMP VALVE CO. 846 WIOTA STREET PHILADELPHIA, PA.

JEFFERSON
Specialty **UNIONS**



with the ***RECESSED BRASS SEAT***

Make Better Piping Installations Possible

Jefferson Union Tees with a union on the run are available with pipe ends threaded either All-Female or Male and Female. Used wherever a union is desired near a tee, they assure improvement in piping installations.
All Jefferson Specialty Unions feature the Jefferson Recessed Brass Seat, which, located in a recess away from the runway of the fitting, cannot be dislodged regardless of how far pipe ends are screwed into the fitting.

Write for latest catalog or see your nearest distributor.

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Factories at LEXINGTON 72, MASS., LOCKPORT, N. Y.

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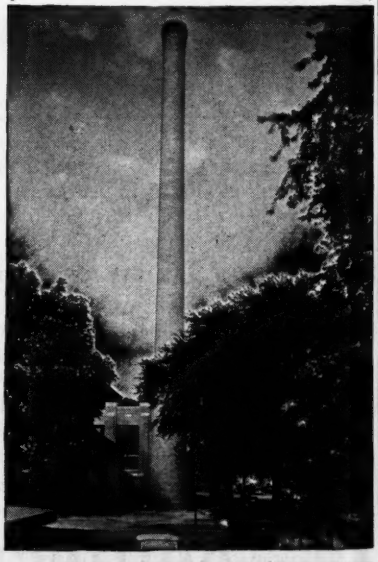

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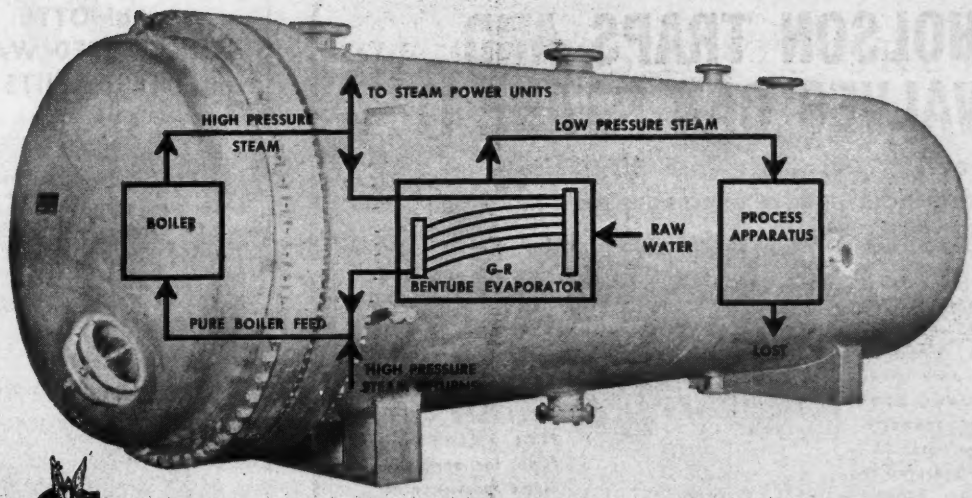
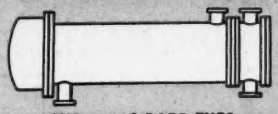


ONLY G-R BUILDS THIS WIDE VARIETY OF HEAT TRANSFER APPARATUS



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Heaters, Coolers, Condensers, Heat Exchangers

G-FIN
Longitudinal-finned elements for greater heat conductivity

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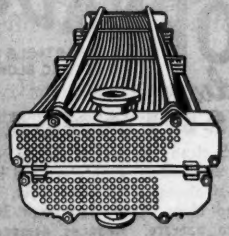
Helical-finned elements for vapors and gases



BENTUBE EVAPORATOR
Scale-shedding Elements

TUBEFLO SECTIONS
Non-clogging design for residuum and other dirty fluids

Investigate This Efficient
THERMAL REDUCING VALVE
If You Use Process Steam

The above simplified flow chart shows how a G-R Bentube Evaporator can serve to produce large quantities of low-pressure steam for process work. The advantages:

THE G-R BENTUBE EVAPORATOR

1. **The high-pressure steam used to operate the evaporator is all returned to the boiler, after use, in the form of condensate.**
2. **No raw, scale-forming make-up or contaminated condensed process steam is fed to the boiler, thus reducing boiler maintenance.**
3. **The scale-shedding heating elements of the G-R Bentube Evaporator maintain rated heat transfer without requiring hand scaling.**
4. **The evaporator is practically 100% thermally efficient.**
5. **Ideal plant heat balance can be arranged.**

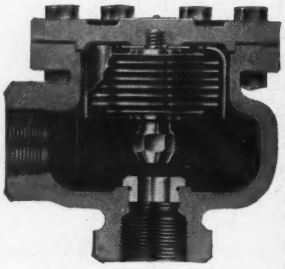
Many millions of pounds per hour of process steam are now being produced in highly successful G-R Bentube Reducing-Valve Evaporator plants. For more complete details, write for free copy of our Bulletin 364.

THE GRISCOM-RUSSELL CO.
285 Madison Ave. New York 17, N. Y.

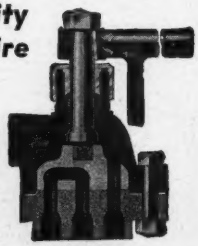
GRISCOM-RUSSELL
Pioneers in Heat Transfer Apparatus

NICHOLSON TRAPS AND VALVES CAN "TAKE IT"

Feature Durability and Simplicity that Maintenance Engineers Admire



NICHOLSON THERMOSTATIC TRAPS — *2 to 6 times greater valve area gives enormous discharge capacity. 5 types: sizes ¼" to 2"; presures to 225 lbs. Bulletin 544.*



CYLINDER CONTROL VALVES — *Types for many mediums; pressures to 5000 lbs. Catalog 543.*

If you're suffering from traps and cylinder control valves that can't stand necessary abuse it's time to inquire about Nicholson units. In plain words, they have the kind of "guts" maintenance engineers admire. Precision-made throughout. For details of exclusive Nicholson features send for catalogs or see Sweet's.

W. H. NICHOLSON & CO. 160 OREGON ST. WILKES-BARRE, PA.

LaMOTTE BOILER FEED WATER TEST UNITS

The LaMotte Research Department has developed a reliable series of chemical tests for boiler feed water control of the following constituents:

Phosphates	**Dissolved Oxygen**
Chlorides	**Sulfates**
Total Alkalinity	**Hardness**
pH (Hydrogen-Ion Concentration)	

For positive control of efficient water treatment, there is a LaMotte Unit for each constituent (Phosphate Comparator, illustrated and described below). Each unit is simple to operate and inexpensive to install. Write for illustrated booklet describing this equipment.

LaMotte Phosphate Comparator

For control of phosphate treatment of boiler feed water. A rapid, simple and accurate method. The new LaMotte Comparator covers phosphate concentrations from 0 to 100 p.p.m. Can also be used for polyphosphates. Outfit comes complete with instructions.

Price $15.00 f.o.b. Towson.

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Cuts your gasket costs in half

The most remarkable tool ever invented.

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THE ALLPAX GASKET CUTTER

Manufactured by

THE ALLPAX COMPANY, INC.

Distributors everywhere — *Mamaroneck, N. Y.*

Boiler Repairs Reduced 75%

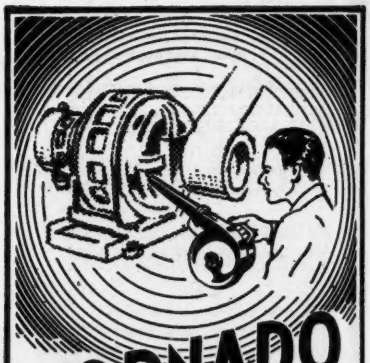
writes user of **NATIONAL GIRTH SEAM PROTECTOR**

We have been using the National Girth Seam Protector for several years and they certainly do the job. . . : Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.

Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 740 REIBOLD BLDG., DAYTON, OHIO



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PORTABLE ELECTRIC BLOWER

reduces **DUST DANGER**

BLOWS clean, dry air, at 295 m. p. h. Cleans out motors, generators and hard-to-get-at-places — removing dust, dirt, lint and chips. Costs less than 3c an hour to operate. Reduces damage to motors and bearings — lessens fire and health hazards.

1 H. P. Universal G. E. motor. Weight, 14 lbs. Portable to any place in plant. Plugs in at convenient outlets. Adaptable as Sprayer for spraying paint and insecticide. Convertible into powerful industrial Vacuum Cleaner —for cleaning floors, walls, ceilings, etc.

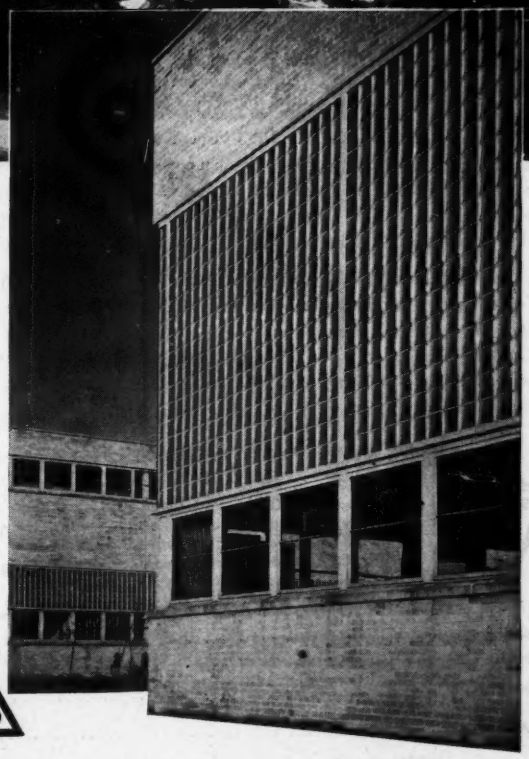
Free Trial—Write to

BREUER ELECTRIC MFG. CO.
5108 N. Ravenswood Ave., Chicago

TAKE THE DUST OUT OF DUSTRY

TORNADO

WHERE THE BOMBSIGHTS GREW



Utility and beauty are combined in the Nassau Plant where bombsights and other vital war precision instruments and equipment were manufactured by Sperry Gyroscope Co., Inc. The plant is modern and functional in design to assure maximum efficiency and comfortable working conditions.

Designed and built by Stone & Webster Engineering Corporation.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

A 16" crack in a 4-foot cylinder head on a cross-compound engine threatened to disrupt service at a large New York electric power plant. Smooth-On Iron Repair Cements put the engine back in service with the repair shown above.

The crack, already one-third as long as the cylinder's width, was stopped from spreading further with bolt ends inserted at each end of crack. With the cylinder hot and under partial vacuum, soft Smooth-On No. 3 was applied along the crack and drawn in by the vacuum. When no more could be absorbed, the crack was coated evenly with a mixture of Smooth-On No. 1 and No. 3. A ½" steel patch plate, also coated with the Smooth-On mixture, was attached with ⅝" bolts around the edges and ¾" bolts at points A, B and C. Under 150 lbs. operating steam pressure this repair stayed tight.

For the past 50 years Smooth-On has been saving the day for engineers in emergencies like this. It has been a standby, too, for routine maintenance repairs. Multi-purpose Smooth-On No. 1 is sold in 1-, 5-, 25- and 100-lb. sizes. Order from your supply house. If they haven't Smooth-On, contact us direct.

FREE POPULAR REPAIR HANDBOOK

40 pages. 170 diagrams. Clear instructions for many short-cut, practical, tested repairs to plant equipment. Pocket size—and should be in the pocket of every engineer and mechanic. Yours, for just sending the coupon.

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Please send me a Smooth-On Handbook

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ADDRESS.....

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Do it with **SMOOTH-ON**
The Iron Repair Cement of 1000 Uses

POWER PLANT *Construction News*

Alaska, Anchorage—Public Utility Department has secured financing, in part through Federal aid, for new municipal steam-electric generating station, for which plans will be prepared soon. Plant will be used also for central steam-heating in downtown area, with distribution system to be installed for this service. Transmission and distribution lines will be built for electric service. Entire project will cost about $1,567,000.

Ark., Helena—Chrysler Corp., 341 Massachusetts Ave., Detroit, Mich., automobiles, is reported planning new branch plant at Helena for manufacture of wood bodies for station wagons, to be operated by Pekin Wood Products Co., a subsidiary interest. It will comprise several large one-story buildings. Electric power equipment will be installed. A steam-generating station is planned. Entire project is estimated to cost approximately $2,000,000, with machinery.

Calif., Ontario—Palmer Candy Co., 209 Douglas St., Sioux City, Iowa, plans installation of electric power equipment in proposed new one-story plant, 100 x 300 ft, at Ontario Blvd., and Bon View Ave., Ontario, where site has been selected. Cost reported over $100,000, with machinery. Work is scheduled to begin soon.

Ill., Cicero—American Can Co., 104 South Michigan Ave., plans installation of electric power equipment in proposed new one-story tin can-manufacturing plant at 50th Ave. and 31st St., Cicero. A boiler house is planned. Entire project reported to cost close to $1,000,000, with machinery. Company engineer, address noted, in charge. Main offices are at 230 Park Ave., New York, N. Y.

Ind., New Haven—City Council plans new pumping station in connection with extensions and improvements in municipal water system, with motor-driven pumping units, controls and accessory equipment. Also will install new 300,000-gal elevated steel tank and tower. Entire program will cost about $110,000. Financing in part has been provided by Federal aid. Zurbuch, Inc., Dime Bank Bldg., Fort Wayne, Ind., is consulting engineer.

Ind., Noblesville—Public Service Co. of Indiana, 110 North Illinois St., Indianapolis, Ind., has plans under way for new generating station near Riverwood dam on White River, vicinity of Noblesville, to be equipped for initial capacity of about 50,000 kw. Cost reported in excess of $1,500,000. Sargent & Lundy, Inc., 140 South Dearborn St., Chicago, Ill., is consulting engineer.

Iowa, Ackley—Town Council plans expansion in municipal power plant, with installation of new Diesel engine-generating unit and complete auxiliary equipment. Cost reported close to $40,000. Proposed to carry out work soon.

Iowa, Ames—State Board of Education, Des Moines, Iowa, has authorized selection of engineer to prepare plans and specifications for expansion and improvements in power plant at Iowa State College, Ames, with installation of additional equipment for increased capacity. Plant is used for power service and central steam-heating supply. Cost estimated about $900,000.

Iowa, Traer—Board of City Trustees has report from Burns & McDonnell Engineering Co., 107 West Linwood Blvd., Kansas City, Mo., consulting engineer, estimating that cost of proposed extensions and improvements in municipal steam-electric generating station, including installation of additional equipment for increased capacity, will approximate $279,900. Project now under consideration and early decision will be made.

Mass., New Bedford—New Bedford Gas & Edison Light Co., Purchase St., Boston, Mass., has plans for new addition to generating plant, with installation of new equipment for increased capacity. Work on superstructure will be placed under way soon. Entire project estimated to cost about $2,500,000.

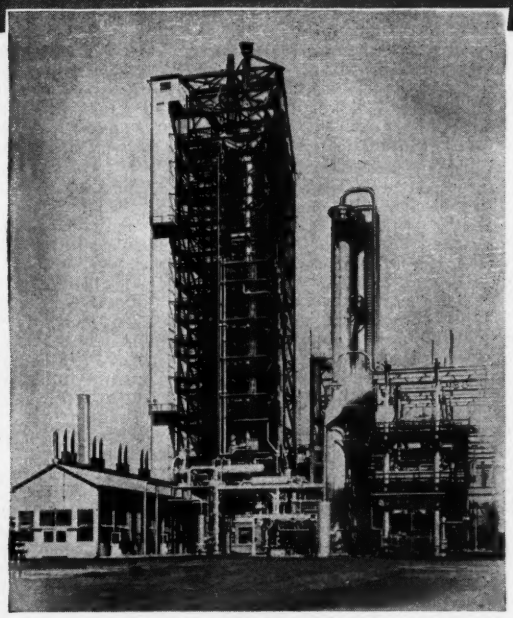
Mich., Marquette—City Commission has authorized plans for addition to municipal power station, with installation of new 2000-kw Diesel engine-generating unit and auxiliary equipment. Estimates of cost will be made soon. Holland, Ackerman & Holland, 20 North Wacker Dr., Chicago, Ill., are consulting engineers.

Mich., Marquette—State Department of Education, Lansing, Mich., plans new power plant at Northern Mich-

Lummus Heat Exchangers

CONTRIBUTE TO *record-breaking run*

of TIDE WATER ASSOCIATED unit



Thermofor Catalytic Cracking Unit, Tide Water Associated Oil Company, Bayonne, New Jersey

This 10,000 barrel a day Thermofor Catalytic Cracking unit, at Tide Water Associated Bayonne refinery, holds the record for the initial run of a TCC plant—240 days—May 12, 1945 to January 7, 1946.

During this run the unit was switched from the production of 100 octane gasoline to the production of motor gasoline from a variety of gas oils and low gasoline content crude oils —evidence of good operating and the adaptability of the unit for wide latitude in output.

The outstanding performance of this unit, which was designed and built by Lummus, incorporating Lummus designed and manufactured heat exchangers, is characteristic of Lummus equipment.

For whatever purposes heat exchange or vacuum equipment is desired, Lummus will design and build it to meet specific requirements, based on a study of the particular manufacturing processes at the individual plant.

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igan College of Education, Marquette, for central-heating service. Cummins & Barnard Co., Ann Arbor, Mich., engineer, will make surveys and plans. No official estimate of cost announced.

Minn., Hayfield—Village Council has engaged Toltz, King & Day, Inc., Pioneer Bldg., St. Paul, Minn., consulting engineer, to make surveys and estimates of cost for a proposed municipal light and power plant, using Diesel engine-generator units and accessories. Work will proceed at once.

Minn., Owatonna—Board of Public Utilities, Walnut St., plans expansion and improvements in municipal power plant, including installation of new turbine-generator unit, condenser and auxiliary equipment. Estimates of cost will be made at once. Pfeiffer & Schultz, Wesley Temple Bldg., Minneapolis, Minn., are consulting engineers.

N. J., Union—Adams Stamping Corp., 322 Adams St., Newark, N. J., stamped metal products, plans installation of electric power equipment in proposed new one-story plant, about 225 x 350 ft, on State Hy. No. 29, Union, where large tract of land has been acquired. A boiler house is planned for central heating service. Entire project will cost over $250,000.

N. Y., Olean—Thatcher Mfg. Co., Kingsbury Ave., Elmira, N. Y., milk bottles, plans installation of electric power equipment, glass furnaces, mechanical-handling and other equipment in new addition to branch plant at Olean, comprising complete new unit, reported to cost close to $1,500,000 with machinery. Proposed to begin work in near future. Franklin B. Pollock is president.

N. Y., Rochester—Eastman Kodak Co., Kodak Park, cameras, processed papers, etc., has plans for addition to power plant for factory service, with installation of equipment for increased capacity. Contract for erection of steel frame superstructure will be awarded soon. No official estimate of cost announced.

N. C., Durham—Liggett & Myers Tobacco Co., plans installation of electric power equipment in proposed new five-story cigarette factory, to occupy block of property bounded by West Main, Fuller, Duke and Peabody Sts. Cost reported close to $3,000,000, with machinery. Planned to begin work in near future. Main offices are at 4241 Folsom St., St. Louis, Mo.

N. D., Fargo—Minnkota Power Cooperative, Inc., Grand Forks, N. D., has plans maturing for new steam-electric generating station in vicinity of Fargo, with erection scheduled to begin in near future. Fund of $1,500,000 has been arranged for this and about 180 miles of primary and secondary lines for extensions in rural electric system in Fargo and other areas. Ellerbe & Co., First National Bank Bldg., St. Paul, Minn., are consulting engineers.

Ohio, Newark—Water and Light Department has authorized plans for expansion and improvements in municipal power plant, including installation of new 1000-kw turbine-generator unit, condenser and auxiliary equipment. Cost reported close to $100,000. Willard Pistler, 4 West 7th St., Cincinnati, Ohio, is consulting engineer.

Ohio, Oxford—Village Council is considering installation of a municipal power plant and has engaged Wilson W. Kohl, Fremont, Ohio, consulting engineer, to make surveys and estimates of cost, including municipal electrical distribution system. Proposed to use Diesel engine-generating units and accessories.

Pa., Middletown—Metropolitan Edison Co., Reading, Pa., has plans for addition to generating station at Middletown, with installation of new turbine-generator, boiler and auxiliary equipment for increased capacity. Work on steel frame superstructure will be placed under way soon. No estimate of cost announced. Gilbert Associates, Inc., 412 Washington St., Reading, is consulting engineer.

Pa., Warren — Pennsylvania Electric Co., Johnstown, Pa., has completed plans and will begin work soon on new generating plant at Warren, consisting of a multi-story building, about 150 x 256 ft, to be equipped for large capacity. Cost reported close to $5,000,000, with turbine-generators, high-pressure boilers and auxiliary equipment. Extensions will be made in transmission lines, power substations and other facilities. It is understood that completion is scheduled late in 1947.

Wis., Green Bay—Hoberg Paper Mills, Inc., 800 Elm St., tissue and other papers, has plans under way for new steam-generating plant at "A" division mill, on East River, with installation to include two boilers, each with rating of about 550 lb. steam, and auxiliary equipment. Cost reported close to $500,000. Proposed to begin work next fall. Helmick, Edeskuty & Lutz, Essex Bldg., Minneapolis, Minn., are consulting engineers.

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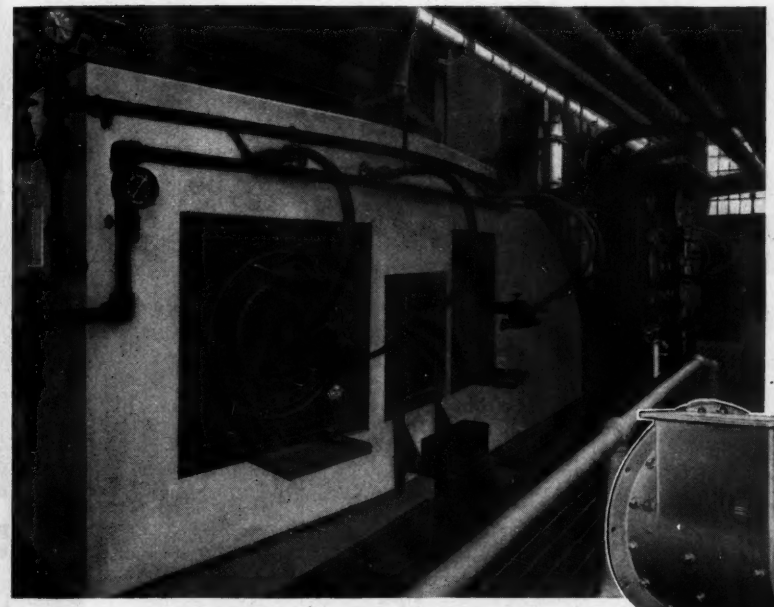

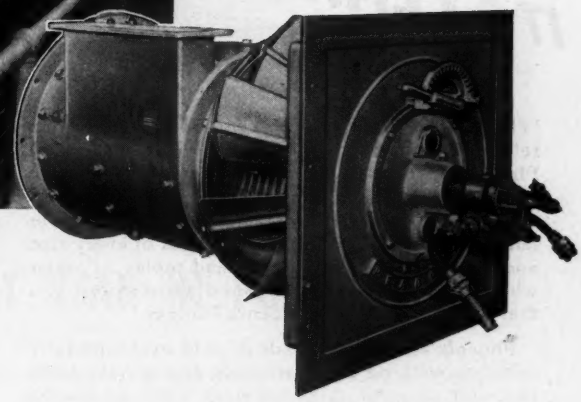

Above: A wartime conversion to pulverized coal and oil. *Right:* Peabody Combined Burner for gas or pulverized coal, and also equipped for wide range oil firing.

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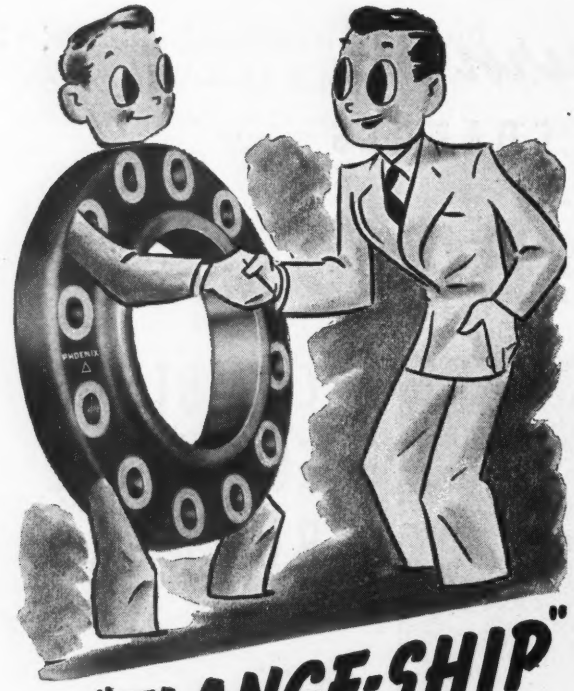

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FEED WATER REGULATORS

assure correct water supply to your busy boilers . . .

A simple dependable system featuring:

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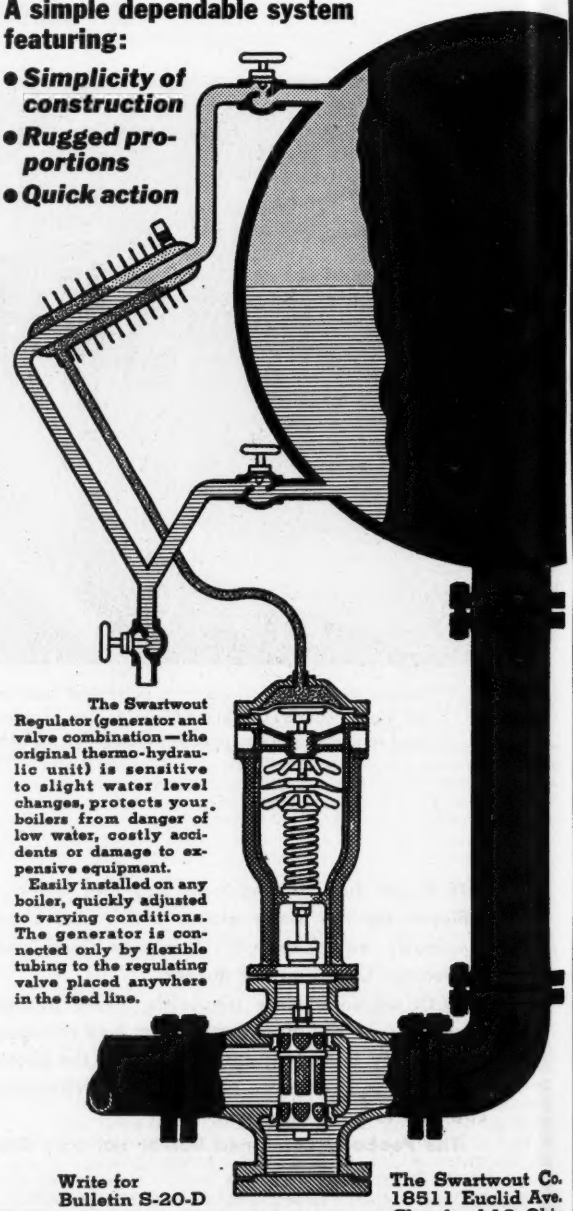

The Swartwout Regulator (generator and valve combination—the original thermo-hydraulic unit) is sensitive to slight water level changes, protects your boilers from danger of low water, costly accidents or damage to expensive equipment.

Easily installed on any boiler, quickly adjusted to varying conditions. The generator is connected only by flexible tubing to the regulating valve placed anywhere in the feed line.

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Feed Water Regulators • Pump Governors • Feed Water Heaters
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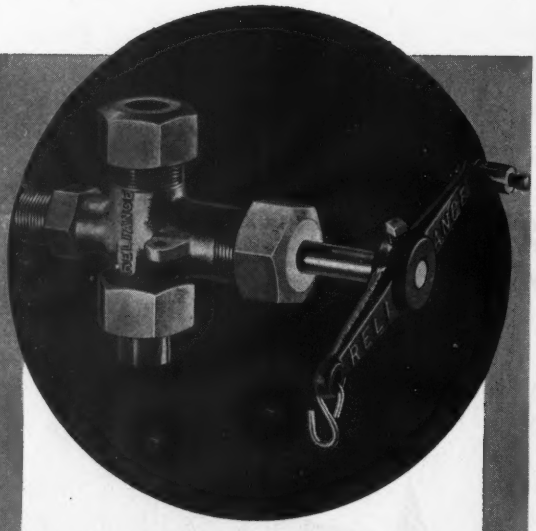

For Leak-Proof Gage Service Use RELIANCE GAGE VALVES

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Reliance exclusive designs and precision manufacture assure you rugged, efficient gage service and long, low-maintenance valve life. Write for Bulletin 418 today.

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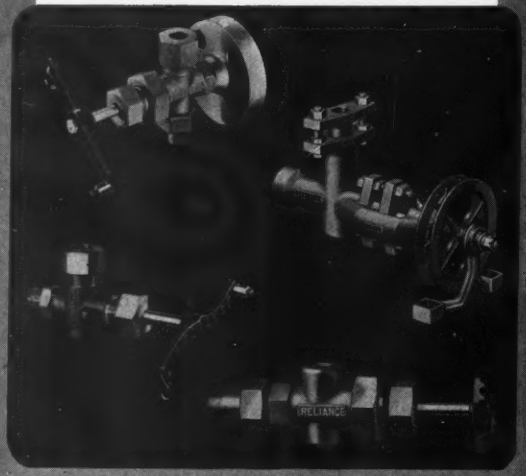
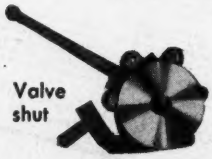


Reliance

BOILER SAFETY DEVICES SINCE 1884

Valve open and locked open



Valve shut

No matter WHAT happens on this boiler water-column line—this plant will not be shut down for repairs. Nor will the boiler-room crew be exposed to any danger while repairs are made.

These EVERLASTING water-column valves *keep your boilers going* . . . keep connections to water-column free from clogging . . . permit replacement of broken gage glasses . . . allow repairs to try-cocks and gage-cocks—without danger of your men being scalded while repairs are made.

Shut these EVERLASTING valves with a quick, easy short-stroke push on the lever—and you have a drop-tight seal. No need to protect face and hands from leaking steam or water—*there is none!* No need to reduce steam-pressure or unduly hurry repairs—*your men are SAFE!*

After repairs are completed . . . open these EVERLASTING valves . . . and seal the levers open. The valve indicators always show clearly which position the valves are in. And when they're open, these valves provide a straight-through unimpeded flow that *prevents* clogging.

EVERLASTING water-column valves meet all A.S.M.E. code specifications—*plus!* They have always been preferred by experienced engineers because they have proven safest on thousands upon thousands of installations. Write today for Bulletin on these valves and our complete line of blow-off valves. EV-276

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Castable Refractories are factory-prepared mixtures of LUMNITE and selected aggregates. They are mixed with water on the job and cast into place for door linings, arches, baffles or furnace walls. Special shapes can be cast in molds, ready for use within 24 hours.

Castables to meet different temperature and insulation needs are made by refractory manufacturers and sold by their distributors.

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Coal Bunker lined with Corrosion-Resistant Concrete. Steel or concrete bunkers, bins and silos can be protected from abrasive wear and corrosive attack with LUMNITE linings—cast-in-place, plastered or applied with a cement gun.

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Heat Exchangers
AND
Process Equipment

This Freon Chamber represents a marked advance in the design and construction of coolers. It is an indication how wide awake Patterson-Kelley engineers are to the trends... how well they have anticipated the industry's requirements in Freon Coolers.

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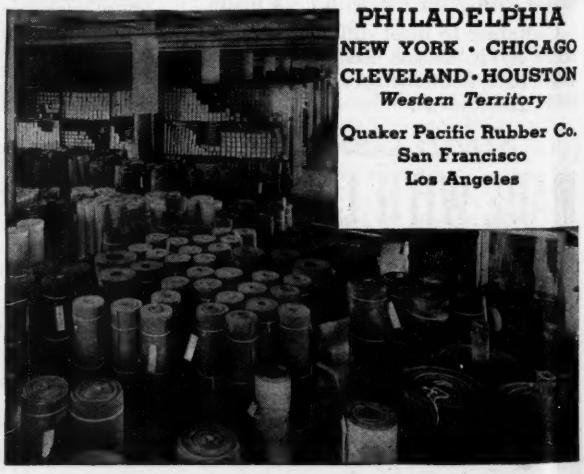
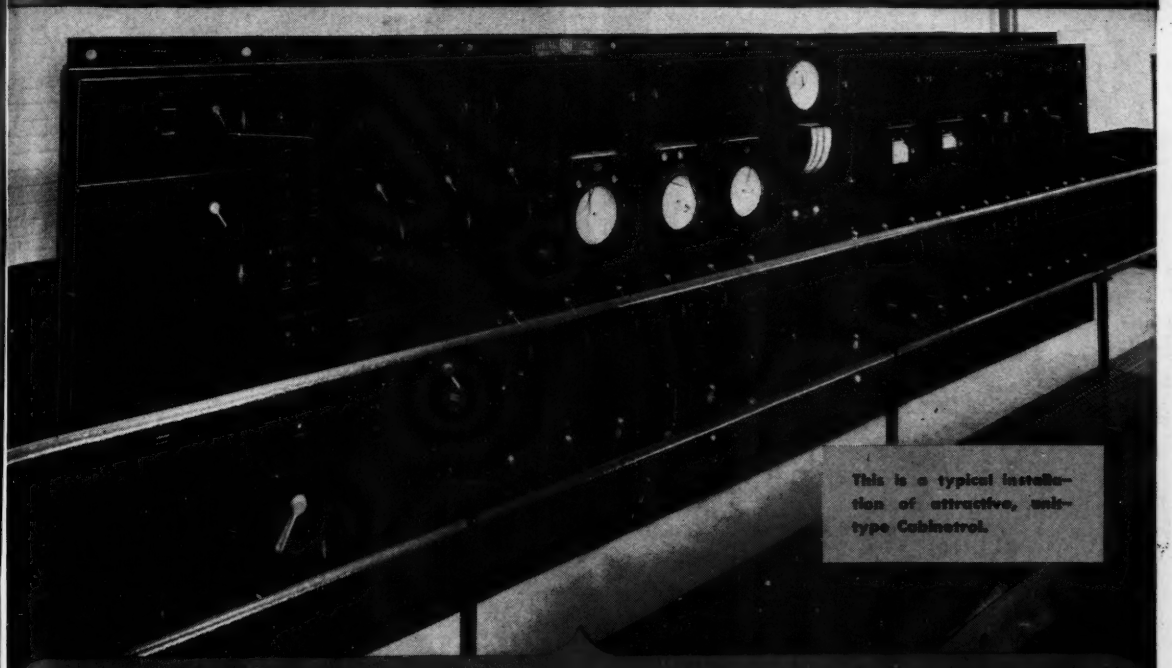


HODGE-PODGE CONTROL IS EXPENSIVE!



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Cabinetrol is based on the use of standard enclosures equipped with the right combination of standard control devices. Each unit is pre-engineered to meet your specific requirements. All starters and accessory equipment necessary to your application are incorporated in the Cabinetrol unit before it is shipped.

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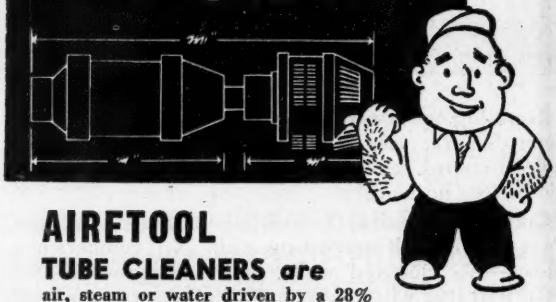
— and... here's the ANSWER to your TUBE CLEANING PROBLEMS



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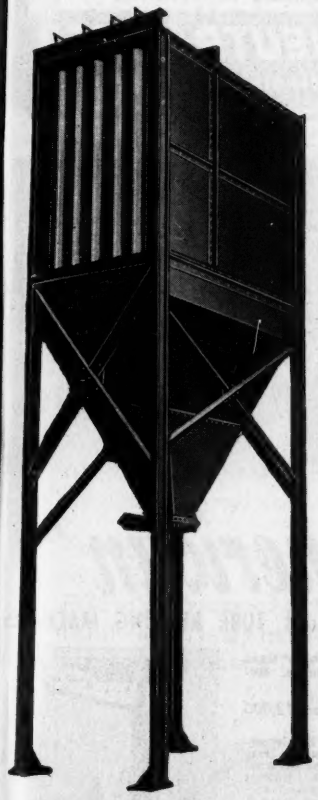
Combines ECONOMY *with* EFFICIENCY



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- Low first cost—fits readily into existing systems.
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- Long life—twelve years' continuous service without replacement parts!

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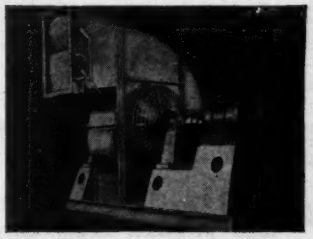
- Efficient for stokers.



GREEN'S *Mechanical Draft* FANS GIVE TOP PERFORMANCE

High efficiency and satisfactory performance are assured with Green's Mechanical Draft Fans because they are engineered for the job. Specifications, design data and operating characteristics are given in Bulletin 166.

NOTE THESE REPEAT ORDERS!—Boston Elevated Ry. Co.—Brooklyn Edison Co.—Calco Chemical Co.—City of Fort Wayne, Ind.—City of Wyandotte, Mich.—Continental Paper Co.—Defense Plant Corp.—Eastman Kodak Co.—Fitchburg Gas & Electric Co.—General Electric Co.—Hudson Coal Co.—Interboro Rapid Transit Co.—Knott Hotels Corp.—Lorain Steel Co.—New York Navy Yard—Pennsylvania Power & Light Co.—Pennsylvania R.R. Co.—Peoples Gas & Electric Co.—Phoenix Utility Co.—Pullman-Standard Car Mfg. Co.—Scranton Electric Co.—Stone & Webster Engineering Corp.—J. G. White Engineering Co.

The only attention needed with GREEN'S CINDERTRAP is periodic removal of cinders from the hopper. Absence of water spray eliminates sludge and prevents corrosion. For complete details send for Bulletin 163-A.

THE GREEN *Fuel Economizer* COMPANY INC.

AIR HEATERS · FANS · ECONOMIZERS · CINDERTRAPS

BEACON 2, NEW YORK

BOILER STOP- AND- CHECK VALVES

ABOVE—No. 102

RIGHT—No. 101

DAVIS Stop-and-Check Valves have long been *"Standard for Safety"* in boiler plants throughout the nation.

NO. 101 — Designed particularly for finest high pressure, heavy duty steam plants. Features an external oil dash pot and counter-weighted lever which can be moved by hand at any time to test the valve and also provides visible action. Inside, it is as clean and simple as a streamlined globe valve.

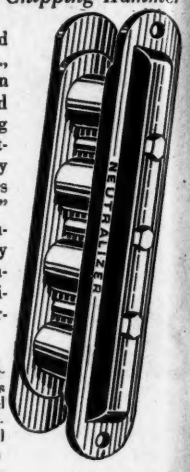
NO. 102 — The popular valve for general service. Features an ingenious valve design with internal steam dash pot eliminating any tendency to chatter.

BOTH TYPES are produced in a complete range of sizes. Globe, angle, corner or elbow body patterns, Semi-steel, carbon steel, or alloy steel bodies with suitable trim for any pressure and temperature. For detailed information, send an outline of your requirements to the DAVIS REGULATOR CO., 2508 S. Washtenaw Ave., Chicago, Illinois.

DAVIS REGULATOR CO.

CASE Histories: Boiler Maintenance

"Scale Had to Be Removed With a Chipping Hammer"



" . . . Condition of boilers bad" read the report on LaVerne Packing Co., LaVerne, Calif. "About ⅛" of scale on pipes and sidewalls, scale very hard and had to be removed with a chipping hammer . . . representative of the Hartford & Steam Boiler Insurance agency able to verify what happened: pipes and sidewalls were down to bare metal." Product guaranteed and proved by thousands of users. Sold by leading Supply Jobbers nation wide, or write for literature and recommendations without obligation. The Electro-Chemical Engineering Co., Louisville 2, Ky.

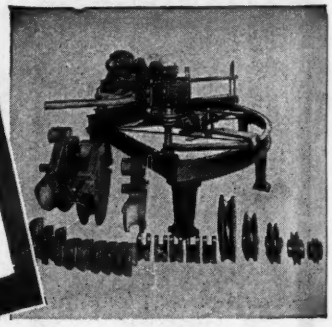
Controls pH value of water automatically Removes old scale, lengthens boiler life, increases steam efficiency, reduces repair cost. Cuts fuel consumption from 15% to 25%. Stops the eating of metal, pitting, foaming, carry-over and all types of corrosion including electrolytic action Produces mineral-free water and pure steam, prevents new scale formation regardless of cause or type.

ELECTRO CHEMICAL ENGINEERING CO., LOUISVILLE 2, KY.

ELECTRO-NEUTRALIZER

FOR WATER CORRECTION AND POSITIVE BOILER-SCALE ELIMINATION

BENDS PIPE EASILY AND QUICKLY INTO ALL SHAPES



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Twelve types to select from. Hand operated capacities ½ to 6" inclusive. Motor operated ¾ to 8" inclusive.

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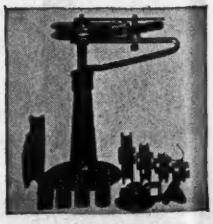

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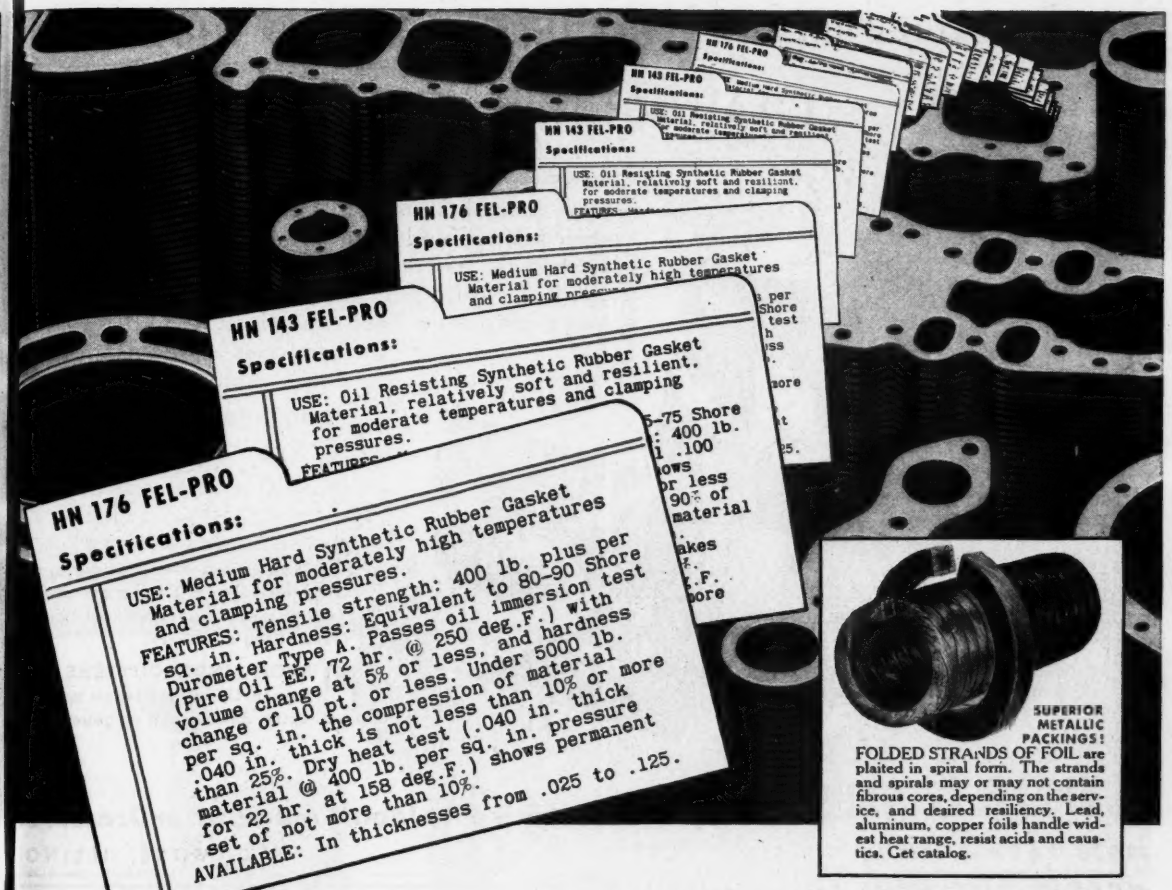
HN 143 FEL-PRO
Specifications:
USE: Oil Resisting Synthetic Rubber Gasket Material, relatively soft and resilient, for moderate temperatures and clamping pressures.
HN 176 FEL-PRO
Specifications:
USE: Medium Hard Synthetic Rubber Gasket Material for moderately high temperatures and clamping pressures.
HN 143 FEL-PRO
Specifications:
USE: Oil Resisting Synthetic Rubber Gasket Material, relatively soft and resilient, for moderate temperatures and clamping pressures.
HN 176 FEL-PRO
Specifications:
USE: Medium Hard Synthetic Rubber Gasket Material for moderately high temperatures and clamping pressures.
FEATURES: Tensile strength: 400 lb. plus per sq. in. Hardness: Equivalent to 80-90 Shore Durometer Type A. Passes oil immersion test (Pure Oil EE, 72 hr. @ 250 deg.F.) with volume change at 5% or less, and hardness change of 10 pt. or less. Under 5000 lb. per sq. in. the compression of material .040 in. thick is not less than 10% or more than 25%. Dry heat test (.040 in. thick material @ 400 lb. per sq. in. pressure for 22 hr. at 158 deg.F.) shows permanent set of not more than 10%.
AVAILABLE: In thicknesses from .025 to .125.

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FOLDED STRANDS OF FOIL are plaited in spiral form. The strands and spirals may or may not contain fibrous cores, depending on the service, and desired resiliency. Lead, aluminum, copper foils handle widest heat range, resist acids and caustics. Get catalog.

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Synthetic gasketing material took giant forward strides here at Fel-Pro during war-time. So great, in fact, that while we now can offer synthetic materials far superior to conventional materials on many oil industry applications, still, ALL possibilities in these great new products are not yet proved and catalogued.

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MY NAME.....

1637

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IDEAL MOTOR MAINTENANCE EQUIPMENT

New motors are still scarce; conserve the ones you have.

When Commutators and Slip Rings show signs of wear, when spitting and burning indicate high mica, etc., a few minutes use of IDEAL Motor Maintenance Equipment will restore original high efficiency. IDEAL Tools used periodically keep Commutators and Slip Rings "good as new" and prevent costly shutdowns.

1. **RESURFACERS** (Hand Type) Remove pin ridges, roughness and small flat spots from Commutators and Slip Rings, while the armature rotates in its own bearings.
2. **PRECISION GRINDERS** (with Tool Type Resurfacers) Restore surfaces that are badly scored and out-of-round. Easy to mount right on motor frame. No dismantling necessary.
3. **MICA UNDERCUTTERS** (Power Driven) Undercut hardest mica, without taking down motor or generator.

OTHER IDEAL Motor Maintenance Equipment—Carbon Brush Seater, Commutator Cleaning Stone, Commutator Saws and Milling Cutters, Slotting Files, Hand Type Slotter and Scraper, etc.

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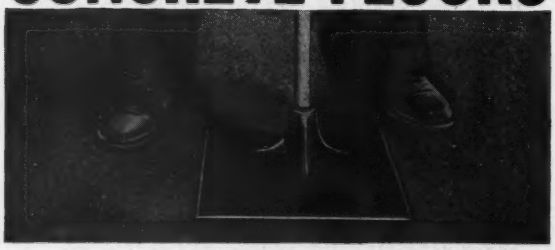
HERE'S THE NEW QUICK WAY TO FIX BROKEN CONCRETE FLOORS



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Please send me complete INSTANT-USE information and details of FREE TRIAL OFFER—no obligation.

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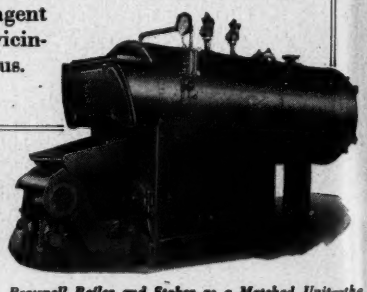
THE EVIDENCE IS NEAR YOU

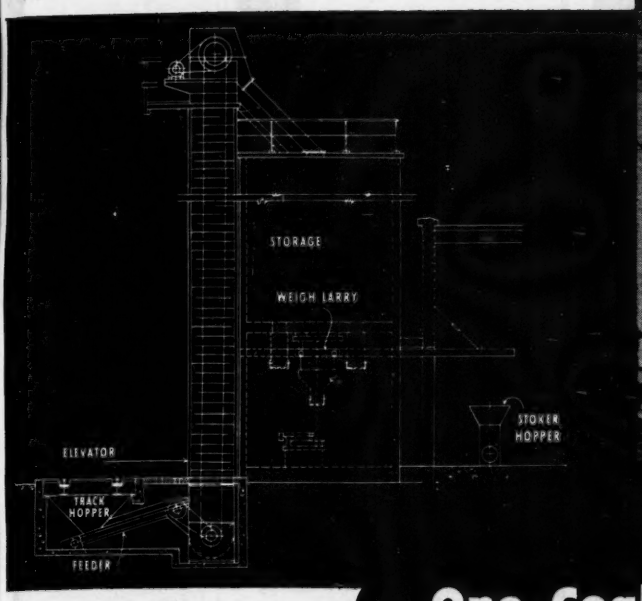
BECAUSE so many Brownell boilers and stokers have been installed during the last 90 years, your local agent can show you Brownell installations in actual service and enable you to secure first-hand evidence from owners. Base your decision upon what you see and hear, but bear in mind that you will obtain the benefit of important improvements in the latest Brownell equipment.

If you do not know the name of the Brownell agent in your vicinity, write us.



THE **Brownell** COMPANY
420 N. Findlay St.
Dayton 1, Ohio

Brownell Boiler and Stoker as a Matched Unit—the Ideal Installation



One Coal-Handling System Does Many Jobs

G-W Bucket Elevator and Coal Storage Pocket

(Below) G-W Drag Feeder delivers coal from railroad track hopper to boot of bucket elevator

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faster • easier • cheaper

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SINCE 1814

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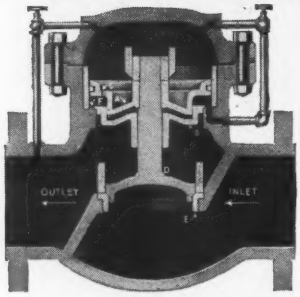

Golden Anderson HYDRAULIC Double Cushioned Check VALVES

An excellent example of the outstanding engineering built in every Golden-Anderson Valve. Designed for high pressure boiler feed lines, the double cushioning feature prevents any shock or jar in sudden valve closure. Needle valve control allows close adjustment to regulate the operating speed for any operating condition. Also available with manual handwheel control, in angle or globe patterns, sizes 2½" to 14".

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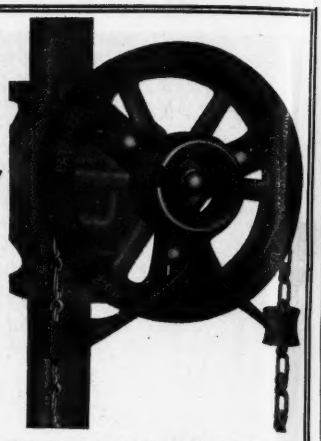
For All "HIGH-UP" VALVES



Every overhead valve in your plant should have the easy, safe, instant control from the floor which Babbitt Sprocket Rims provide. . . . Babbitt Rims are low in cost; quickly attached; they save time, steam and accidents. Install them now. Write for descriptive folder.

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SPROCKET RIM
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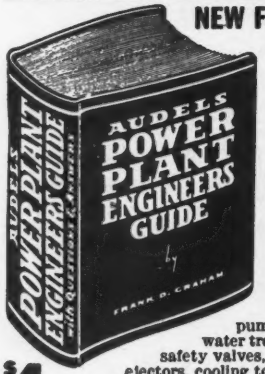

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- ☐ Enclosed is a sketch of a prospective underground pipe job.
- ☐ We shall be glad to have your quotation.
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- ☐ Please send representative.
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One of the first Diesel engine manufacturers in this country, Fairbanks-Morse has pioneered a notable list of Diesel improvements. As a result, Fairbanks-Morse Diesels have earned an enviable reputation for outstanding performance.

Their operating records prove their low operating costs and low maintenance costs... prove, too, that they have the stamina to stand up year after year in sustained, heavy-duty service.

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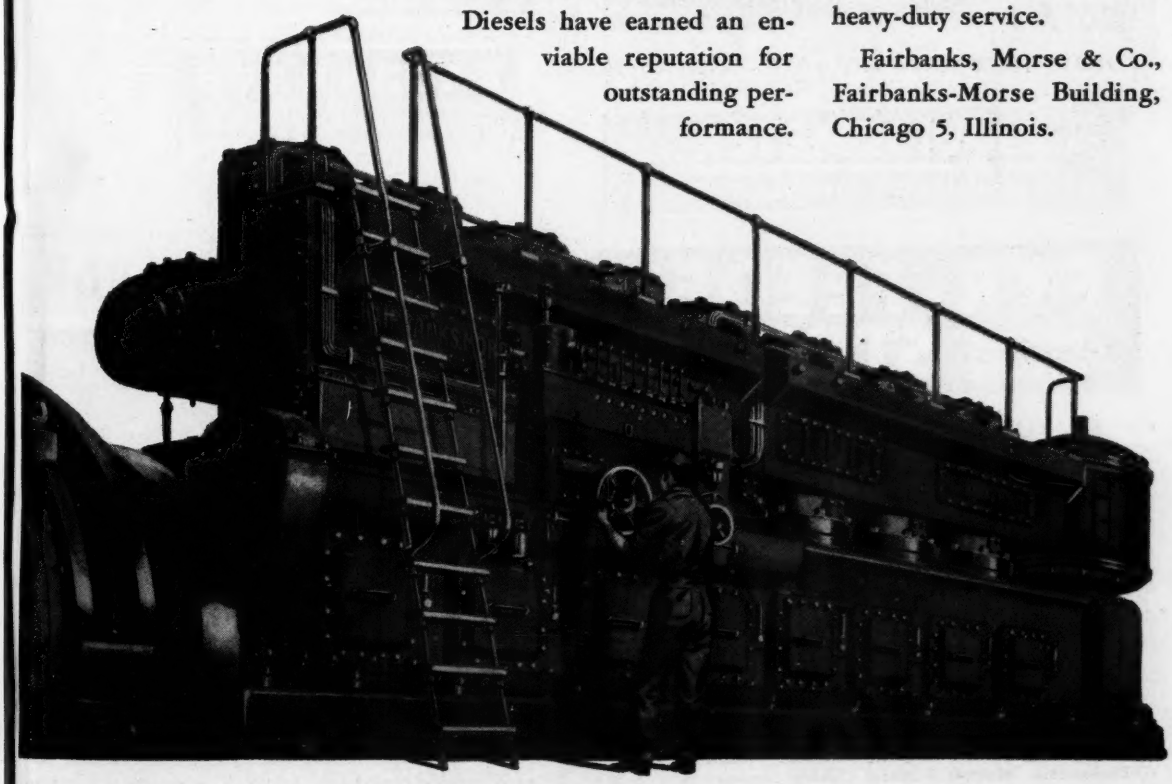

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Diesel Locomotives • Diesel Engines
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FOR GAUGING LIQUIDS OF ALL KINDS

APPROVED BY UNDERWRITERS' LABORATORIES

WRITE for COMPLETE DETAILS

"LIQUIDS WORTH STORING ARE WORTH MEASURING"

THE LIQUIDOMETER CORP.
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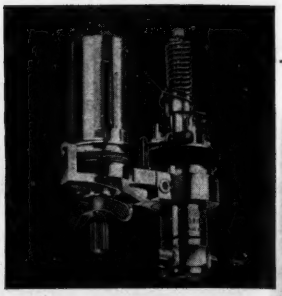
TYPE 2-CP ENGINE INDICATOR for PROTECTIVE ENGINE MAINTENANCE



You can help maintain original engine efficiency, assure uninterrupted power and maximum fuel economy by making regular indicator check-ups with the 2-CP Indicator. It is the recognized "standard" card-drawing indicator for Diesel service, and is also in widespread use on steam engines, gas engines, compressors, and pumps. Bulletin 279 describes application of the 2-CP Indicator for protective engine maintenance in easy-to-understand language. Write for it today

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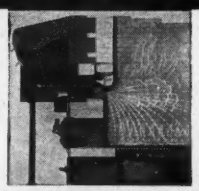

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• FYR-FEEDER pays for itself in coal and labor savings. • Automatic, modern, high efficiency firing at its best! • Increases boiler capacity with cheapest grades of coal—screenings or sweepings, wet or dry. CUTS FUEL BILLS! • Easy to operate. Responds instantly to sudden load changes. Burns fines in suspension; larger pieces on grate. Beautifully clean flame. • Safe, Dependable. Multiple Burners. Quality construction. • Easily installed in minimum time. Standard ratings from 100 to 12,000 lbs. of coal per hour. Wire, phone, or write.

FYR-FEEDER Multiple SPREADER STOKER
IT'S EFFICIENT
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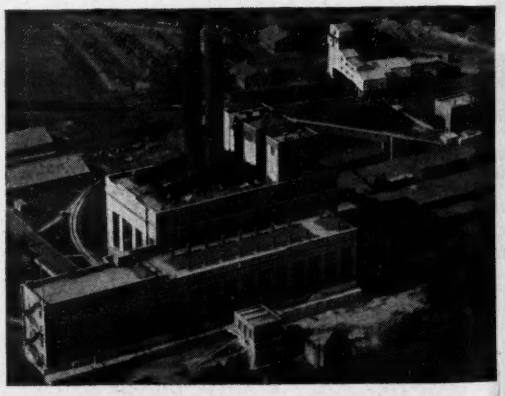
☐ Interested in FYR-FEEDER Dealership
☐ Interested as Sales Representative
☐ Send literature and delivery information
☐ Have representative call
Name
Company
Address

"PENNSYLVANIA"



A unique Central Station with a Coal Mine on one side, and a River on the other—where the coal is prepared by 2 of the more than 60 "Pennsylvania" Bradford Coal Breaker and Cleaner installations in the U. S. Central Stations.

Forty years' experience—at your service.

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Associated with Fraser & Chalmers Eng. Works, London

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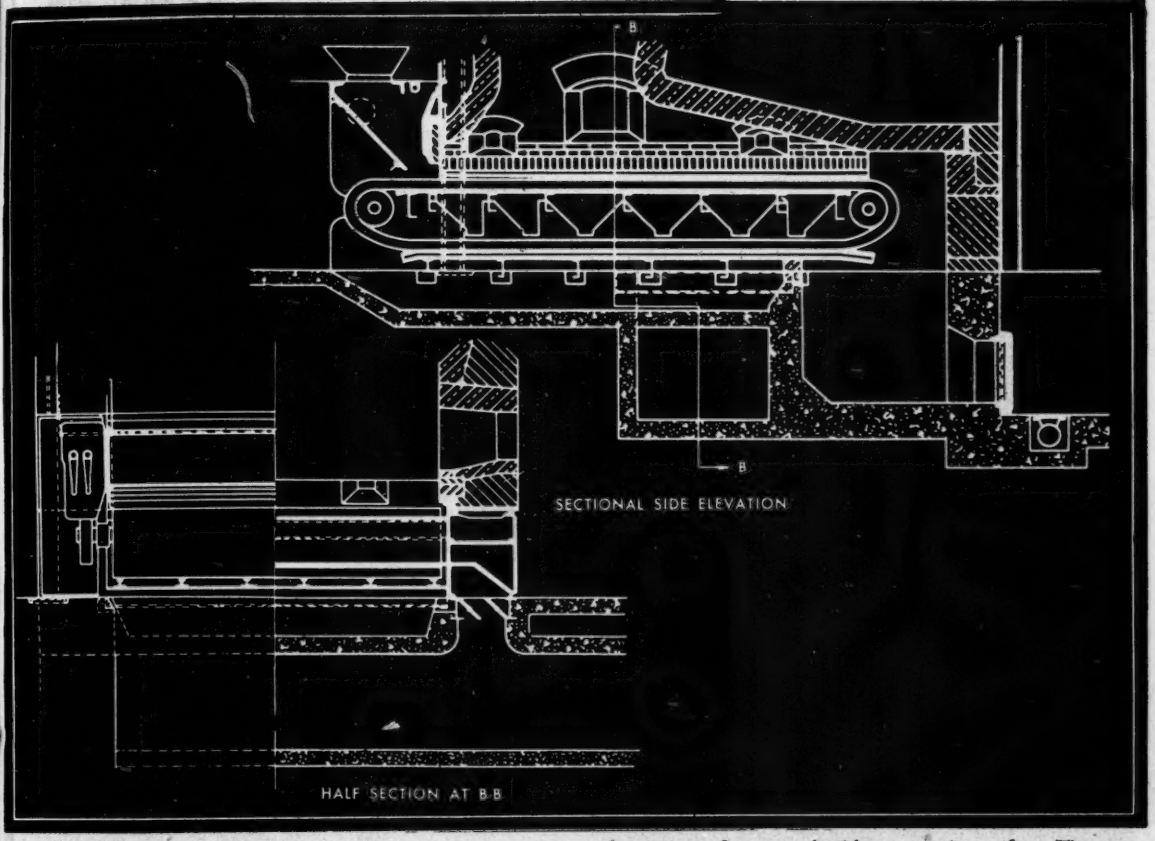
COAL PREPARATION

Designed for Efficiency

WALL BRICK DATA

McCLAVE Forced Draft Chain Grate STOKER



In terms of more steam at less cost, this installation of a CARBOFRAX silicon carbide brick setting with a McClave Stoker clearly illustrates sound engineering. Although varying operating conditions determine coverage height of lining—increased furnace efficiency is a foregone conclusion.

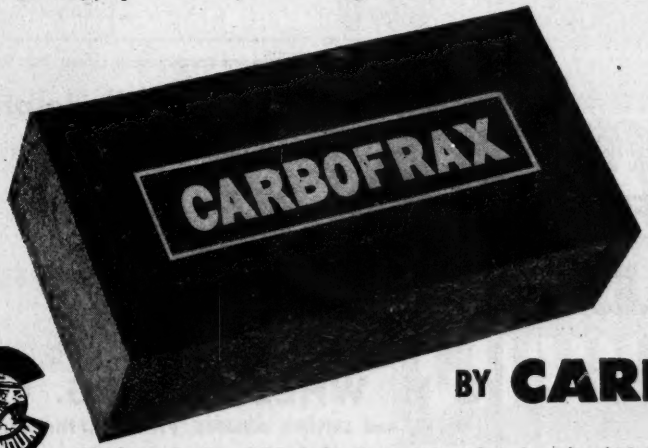
Statements such as these are not unfounded claims. They are supported by actual operating reports. Briefly summarized, they echo confirmations of:

Greater steaming capacity
Improved combustion conditions
Longer periods of continuous operation
Lower labor and refractories costs

All these advantages result directly from the super refractory properties of CARBOFRAX brick. There is no softening at high temperatures. Hence, large clinker formations cannot anchor or build out on the surface. The moving fuel bed tends to keep walls clean thereby lessening the frequency and difficulty of barring. The entire grate area is more effectively utilized . . . a more active fire maintained . . . fuel combustion improved and cost cut.

Of equal importance is the exceptional strength and resistance to mechanical and flame abrasion of CARBOFRAX brick. They do not wear or cut back. 8 to 10 years service is not exceptional. Outages for lining repairs are rare. Dependable on-line service is consistent.

Then, too, there are other benefits that make themselves known in improved operating reports. A factual, illustrated, technical booklet "CARBOFRAX in Boiler Furnaces" tells the complete story. For more specific information pertinent to your own furnaces, we will gladly cooperate. In either case, don't put off writing Dept. H-56, The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.



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Largest Pipe Coil Plant in the U. S. A.
57 Years' Experience

New Methods New "Know-How"

REMPE PIPE COILS

Coils, Bends, Assemblies, for ice and refrigerating plants, cold storage houses, chemical works, blast furnaces, soap factories, feed water heaters, car heaters, all purposes for which bent pipe is used.

Illustrated is one example of many. Large chemical lead coil and steel tank assembly, designed and built by Rempe. The Rempe method of lapping lead pipe ends over steel flanges eliminates possibility of contamination.

Bring your pipe coil problems to Rempe for *experienced* counsel in all fields. Wire, phone or write, or, if possible, come and see us.

REMPE COMPANY
344 No. Sacramento Blvd., Chicago 12, Ill.

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A Little
GAMLENOL
MAKES THIS
BIG *Difference*
IN FUEL OIL

Untreated oil readily reacts with water to form an emulsion, or sludge.

Gamlenol-treated oil does not combine with water; sludge formation is prevented.

POUR a comparatively small amount of Gamlenol into the fuel tank, through fill line or sounding pipe. The effect is immediately noticeable, for Gamlenol dissolves sludge throughout the system, clearing lines, coils, preheaters, strainers, injectors, burner tips. And, its regular use in small quantities prevents re-accumulations. Gamlenol greatly improves atomization and combustion, and increases firing efficiency, which results in more heat and power from every gallon of oil.

Gamlenol is safe, non-explosive, approved as ships' stores. It contains no acid, soda ash, caustic soda, or alkalis.

Ask nearest Gamlen representative for details, or write for Bulletin 455.

GAMLEN CHEMICAL COMPANY

1469 Spring Garden Avenue—Pittsburgh 12, Pa.
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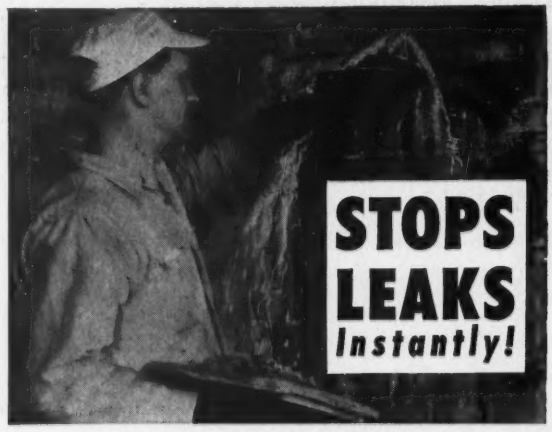
• Service and Stocks in All Principal Cities and Ports



Makes Basements Bone-Dry!

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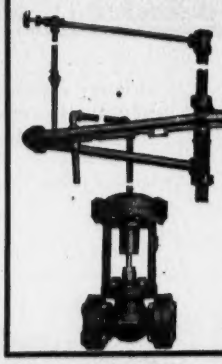

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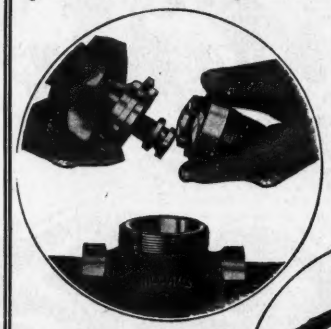
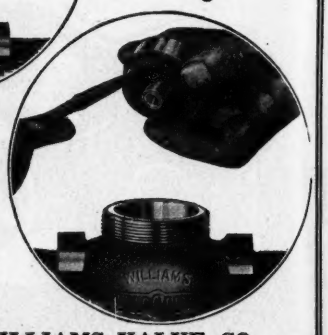
SERVES EVERY INDUSTRY USING HEAT

Use **VULCODISC**

for trouble-free valve jobs



In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.



Dense without being brittle — tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact, its absorption is less than 1 per cent. . . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.

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SELF-ADJUSTING FOR WEAR

When the "buckets" (swinging vanes) finally wear out, a 20-minute replacement job restores the pump to normal capacity. Twenty years of service is not unusual.

WRITE FOR Bulletin No. 307—Facts about Rotary Pumps.

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1—1500 KW, 80% P.F. 1875 KVA, 3600 RPM, 240 volt, Condensing Turbine.

1—Extra Rotor—New.

1—14 KW, 125 volt, 1800 RPM, D.C. Exciter direct connected to 220 volt, 3 phase, 60 cycle motor with field rheostat and motor compensator.

1—15 KW, 125 volt, 4500 RPM, non-condensing excitor (steam set) set.

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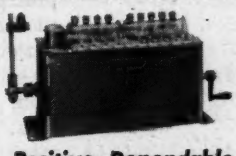

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THE MERCOID CORPORATION
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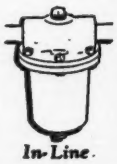
Come out of your "jungle" to SIMPLIFIED *piping*



In-Line

Elbow

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This engineered steam trap gives you the choice of BOTH elbow and straight-in-line connections using only one fitting, a nipple. You save as much as six fittings and 40 minutes of installation time per trap. Yes, and all this without resorting to split gaskets or cored passages.

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Protect Your Boilers Against Pitting, Corrosion and Scale with

Magic
BOILER PRESERVATIVE

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Established 1904

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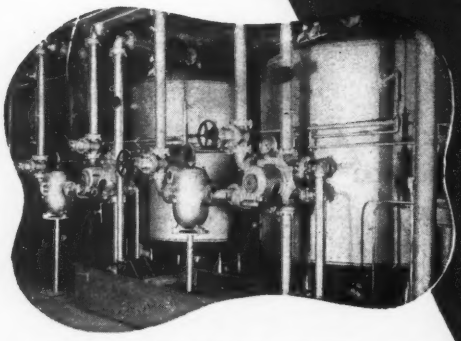

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